



DOCUMENT 126-17

TMATS / IHAL / DDML SCHEMA VALIDATION

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Preface

This document describes the results of the Inter-Range Instrumentation Group (IRIG) schema validation task performed under the direction of the Range Commanders Council (RCC) Telemetry Group (TG) Data Multiplex Committee.

The purpose of this task was to create a method for performing IRIG eXtensible Markup Language (XML) schema validation. As opposed to XML instance document validation that determines if an XML instance document conforms to a schema, this method is used to validate that the XML schema can model the scenarios it was intended to support. This task includes validation of the current schemas and the creation of a framework and methodology through which future versions of the schema can be thoroughly validated prior to release. To meet the task objective, a set of user stories, test cases, and instance documents was defined over a subset of intended functionality.

The RCC gives special acknowledgement for production of this document to the TG Data Multiplex Committee. Please direct any questions to the committee point of contact or to the RCC Secretariat as shown below.

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Acronyms

DDML	Data Display Markup Language
HUD	heads-up display
iNET	integrated Network Enhanced Telemetry
IRIG	Inter-Range Instrumentation Group
PCM	pulse code modulation
POC	point of contact
RCC	Range Commanders Council
RF	radio frequency
SVG	Scalable Vector Graphics
T&E	test and evaluation
TMATS	Telemetry Attributes Transfer Standard
TmNS	telemetry network system
XML	eXtensible Markup Language

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1. Introduction

The purpose of this document is to create a method for performing IRIG XML schema validation for the Telemetry Attributes Transfer Standard (TMATS), Instrumentation Hardware Abstraction Language (IHAL), and Data Display Markup Language (DDML) schemas. This method is used to validate that the XML schema can model the scenarios it was intended to support as opposed to XML instance document validation that determines if an XML instance document conforms to a schema. This task includes validation of the current TMATS, IHAL, and DDML schemas and the creation of a framework and methodology through which future versions of the schema can be thoroughly validated prior to release.

The TMATS provides the common definition of the set of information needed to fully describe the data being transmitted from, or recorded on, an item under test. A TMATS file serves as the medium of exchange between the information source (usually an instrumentation organization) and the user (usually a test range). For more details on TMATS, see the TMATS Handbook.¹

The IHAL standard is a specification of an XML-based format for describing instrumentation hardware. The IHAL language is focused on the settings available on devices, referred to as “configurable attributes.” The primary purpose of IHAL is to describe these attributes both in terms of how they are currently configured and how they can be configured. For more details on IHAL, see the IHAL Handbook.²

The DDML standard is a specification of an XML-based neutral format that is intended to be the inter-lingua of data displays. The DDML language has the requirement of being generic enough to encompass various vendor-specific data display formats and at the same time being unified (not a loose grouping of XML-ized vendor formats). In addition, it is required to support reusable concepts (such as variables and data sources), be robust (e.g., use of cross-references), and support future objects without warranting a change of the DDML format. For more details on DDML, see the DDML Handbook.³

The rules of an XML schema govern XML instance documents. For information about XML, refer to RCC 125-15, XML Style Guide.⁴

The remainder of this document lays out an approach for performing schema validation and documents user stories/scenarios, test cases, and deficiencies for the TMATS, IHAL, and DDML schemas.

¹ Range Commanders Council. *Telemetry Attributes Transfer Standard (TMATS) Handbook*. 124-17. January 2017. May be superseded by update. Retrieved 1 February 2017. Available at http://www.wsmr.army.mil/RCCsite/Documents/124-17_TMATS_Handbook/.

² Range Commanders Council. *Instrumentation Hardware Abstraction Language (IHAL) Handbook*. 128-17. January 2017. May be superseded by update. Retrieved 1 February 2017. Available at http://www.wsmr.army.mil/RCCsite/Documents/128-17_IHAL_Handbook/.

³ Range Commanders Council. *Data Display Markup Language (DDML) Handbook*. 127-17. January 2017. May be superseded by update. Retrieved 1 February 2017. Available at http://www.wsmr.army.mil/RCCsite/Documents/127-17_DDML_Handbook/.

⁴ Range Commanders Council. *XML Style Guide*. 125-15. July 2015. May be superseded by update. Retrieved 28 January 2016. Available at http://www.wsmr.army.mil/RCCsite/Documents/125-15_XML_Style_Guide/125-15_XML_Style_Guide.pdf.

2. Schema Validation Approach

This section describes the approach taken to capture schema validation requirements, as well as a general approach to using these results for validation of both current and future versions of these schemas.

2.1 Approach Overview

In the simplest sense, our schema validation approach involves capturing the requirements of the schemas and then testing the schemas' ability to satisfy those requirements by implementing specific cases of each requirement. In order to achieve this, we have documented three main types of information.

- **User Stories:** A user story describes a specific requirement of the schema in the terms of a user's need. An example of a user's need is "I need to configure an analog signal conditioning card."
- **Test Cases:** For each user story, we capture one or more test cases. A test case is a description of a very specific example of the need described in the user story. An example of a test case is "Configure the analog signal conditioning card with model number ABC123 with the specific settings X, Y, and Z."
- **Instance Documents:** For each user story, we then create one XML instance document. The instance document is a schema-valid XML file that completely describes the information in the test case in a manner that satisfies the user story. If it is not possible to create an instance document for a given test case, then the schema is not valid and requires modification.

The relationships between user stories, instance documents, and test cases are illustrated in [Figure 1](#).

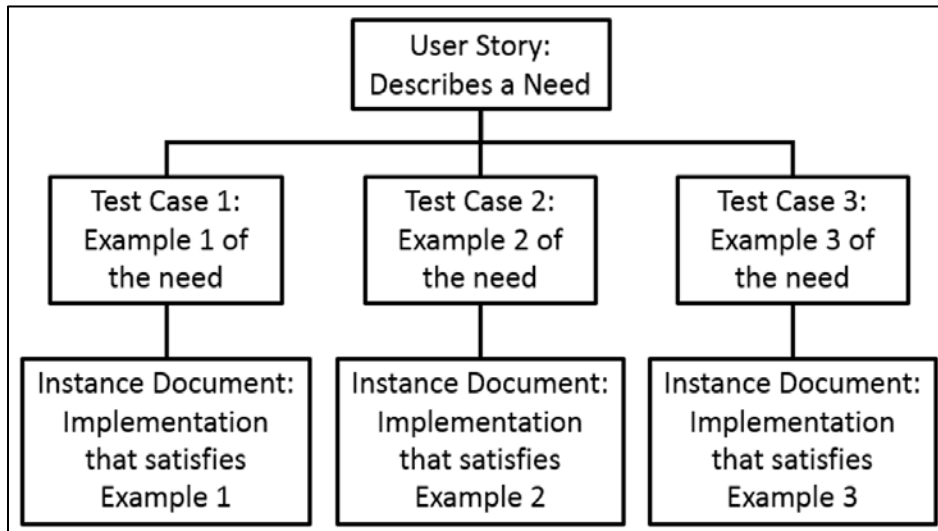


Figure 1. Relationship Between User Stories, Test Cases, and Instance Documents

Under this effort, when a test case could not be satisfied by a schema-valid instance document, we created a description of a schema defect for further investigation by the committee.

2.2 User Story Requirements Capture

The general approach taken for this task is to capture schema requirements using user stories, which are used in the agile software development process to capture the function that a system is to perform. Since an IRIG schema is intended to capture the function that a telemetry system is intended to perform, we feel that user stories are a simple and concise way to capture requirements. The general format of a user story is:

As a/an <user>, I want to be able to <task description>, so that <objective to meet>.

2.3 How to Use These Results

In this section, we describe how to use this document to perform schema validation, as well as how to maintain the document as an accurate and up-to-date guide to schema requirements.

2.3.1 Using this Document to Validate the Schema

With a complete and accurate set of user stories, test cases, and instance documents, schema validation is a 4-step process.

1. **Validate all instance documents against the schema.** This instance document validation checks to ensure that each document is syntactically valid according to the rules laid out in the schema. This step can be performed by a number of automated commercial off-the-shelf and government off-the-shelf tools. If the schema has changed since the initial development of the instance documents, it is expected that some or all of the documents will fail validation.
2. **Determine the cause of failure for any documents that failed validation.** A document will fail schema validation due to a change in either the syntax or content of the standard. If the change is only syntactic, it will be apparent when comparing the invalid document to the schema because all of the data in the document will still have a place in the new schema, but the location or name of the XML element or attribute may have changed. If the change is to the content of the standard, then there will be information in the instance document that does not have an apparent place under the new schema.
3. **Fix the invalid documents and document schema defects.** Once the causes of a document failing validation have been determined, the syntactic differences can be resolved by simply modifying the instance document, making sure that all data content is preserved in the newly formatted document. If there are content changes resulting in data from the instance document not having a place in the newly formatted document, this must be documented as a potential defect in the schema. The schema must then be considered invalid until all defects are addressed.
4. **Address all schema defects.** Each schema defect can be traced back to an invalid instance document, and from there to a specific test case and user story. The committee must compare the test case description to the new schema and determine if there is any

way to support the test case. This is a more thorough version of the analysis described in step 3, in which the schema is looked at as a whole for ways to support the test case. If there is no way to support the test case with the new schema, then the committee must either modify the schema to support the test case, or modify the test case (and possibly the user story) to reflect a change in content requirements.

2.3.2 Maintaining This Document

For proper validation of future versions of the schemas, this document must be maintained to accurately reflect the requirements of the standards. As the committee considers schema changes, it must determine whether the need for these changes has resulted from a requirement being added or removed, from a previously unforeseen example of an existing requirement, or from a need to update the style or syntax of the standard.

When new requirements are identified, a new user story must be added or an existing user story must be re-worded to include the new requirement. Then, a set of test cases should be developed for validating the schema's ability to support the new requirement. Finally, instance documents must be created that implement each test case.

If a requirement is being dropped from the standard (a historical example would be the dropping of support for pulse amplitude modulation from TMATS-XML), then the associated user stories, test cases, and instance documents must be deleted or modified to reflect the change in requirements. The instance documents can be used as a guide to which portions of the schema are associated with the deleted requirement and may aid in determining which schema constructs to remove.

When previously unforeseen examples are discovered, the appropriate user story should be identified and new test cases associated with this user story should be added that represent the new usage example. As before, an instance document should be created for each new user story.

Finally, if the changes are only the result of a need for different syntax, this document will not require any changes; however, the associated instance documents must be updated to reflect the new syntax.

In all cases, the new schema must be validated according to the steps in Subsection [2.3.1](#).

2.4 **Future Work**

The efforts of this RCC TG task have produced a methodology and a framework for performing schema validation; however, there is still work to be done to complete the data needed for full schema validation. Currently, the top-level user stories and most sub-user-stories have been fully fleshed out according to the current understanding of the two standards; however, only a representative set of test cases has been created. The next steps following the completion of the current task are:

1. Address all of the schema deficiencies documented in Section [4.1](#);
2. Create test cases and instance documents for all user stories in Section [3](#) with "TBD" currently listed under "Test Cases";
3. Review the user stories list and add new stories to Section [3](#) as new requirements come to light.

3. User Stories / Scenarios

3.1 TMATS

This section describes the high-level TMATS XML schema validation user stories. The following subsections describe more-detailed user stories to address more specific scenarios.

- US-1. As a test engineer, I want to be able to fully describe the data being transmitted from, or recorded on, an item under test so that I can monitor in-flight progress and process and assess the test results.

Source reference(s): TMATS Handbook⁵, Page 1-2 and 1-3

Test case(s): TBD

Deficiencies: N/A

- US-2. As a test engineer, I want to set up a combined mission of two aircraft that have similar instrumentation such that most measurement names are the same (i.e. AIRSPEED, etc.) and support this out of a single control room with a single setup file.

Source reference(s): Jon Morgan, TMATS C-Group Data Link Name

Test case(s): TBD

Deficiencies: N/A

3.1.1 Signal Characteristics

- US-3. As a test engineer, I want to be able to describe the signal characteristics necessary to decipher digitally encoded data being carried by the signal so that I can monitor in-flight progress and process and assess the test results.

Source reference(s): TMATS Handbook, Page 2-1

Test case(s): TBD

Deficiencies: None

3.1.2 TMATS Metadata

- US-4. As a test engineer, I want to be able to define the data that describes the general information for my test including program name (G\PN), test article (G\TA), IRIG 106 revision level (G\106), origination date (G\OD), point of contact (POC) information (G\POC, G\POC1-1, G\POC2-1, G\POC3-1, G\POC4-1), number of data sources (N/A), data source ID (G\DSI1-1), data source type (G\DST-1), and security classification (G\SC) so that I know why the test is needed.

Source reference(s): TMATS Handbook, Page 2-1, 3-1, 3-2

⁵ Range Commanders Council. *Telemetry Attributes Transfer Standard (TMATS) Handbook*. 124-17. January 2017. May be superseded by update. Retrieved 1 February 2017. Available at http://www.wsmr.army.mil/RCCsite/Documents/124-17_TMATS_Handbook/.

Test case(s): [TC-1](#)

Deficiencies: [D-1](#), [D-2](#)

3.1.3 RF Data Link

- US-5. As a test engineer, I want to be able to describe a radio frequency (RF) data link including data source ID defined in the metadata (T-1\ID), frequency (T-1\RF1), and modulation type (T-1\RF4) so that the transmitter is defined.

Source reference(s): TMATS Handbook, Page 3-3

Test case(s): [TC-2](#)

Deficiencies: [D-3](#)

3.1.4 Multiplex Waveform

- US-6. As a test engineer, I want to be able to describe multiplex waveform attributes including data source ID defined in the metadata, baseband signal type (M-1\BSG1), and data link name (M-1\BB\DLN) so that the multiplex attributes are defined.

Source reference(s): TMATS Handbook, Page 3-3

Test case(s): [TC-3](#)

Deficiencies: [D-3](#)

3.1.5 T Group, R Group, and M Group Linking

- US-7. As a test engineer, I want to tie together transmission data, recorder data, and multiplex data using the data source ID (G\DSI-1 or T-2\ID or M-5\ID) so that test data is linked.

Source reference(s): TMATS Handbook, Page 4-2

Test case(s): [TC-4](#)

Deficiencies: [D-3](#)

3.1.6 Measurement, P Group, and B Group Linking

- US-8. As a test engineer, I want to tie together measurement data, pulse code modulation (PCM) data (P), and bus data (B) using the data link name so that test data is linked.

Source reference(s): TMATS Handbook, Page 4-2

Test case(s): TBD

Deficiencies: [D-4](#)

3.1.7 Linking

- US-9. As a test engineer, I want to be able to link the PCM frame to multiplex waveform and measurements (P1\DLN) so that the test linkages are preserved.

Source reference(s): TMATS Handbook, page 3-4

Test case(s): [TC-5](#)

Deficiencies: [D-5](#)

- US-10. As a test engineer, I want to be able to link the R group, M group, P group, and measurement lists so that the test linkages are preserved.

Source reference(s): General schema validation

Test case(s): [TC-6](#)

Deficiencies: [D-21](#)

3.1.8 PCM Format

- US-11. As a test engineer, I want to be able to define the data that describes the PCM format including data link name (D-1\DLN), PCM format code (P-1\D1), bit rate (P-1\D2), encryption (P-1\D3), polarity (P-1\D4), auto-polarity correction (P-1\D5), data direction (P-1\D6), data randomization (P-1\D7), randomizer length (P-1\D8), type format (P-1\TF), common word length (P-1\F1), word transfer order (P-1\F2), parity (P-1\F3), number of minor frames (P-1\MF\N), number of words in a minor frame (P-1\MF1), sync type (P-1\MF3), synchronization pattern length (P-1\MF4), synchronization pattern (P-1\MF1), in-sync criteria (P-1\SYNC1), sync pattern criteria (P-1\SYNC2), out-of-sync pattern criteria (P-1\SYNC4), number of subframe ID counters (P-1\ISF\N), subframe ID counter name (P-1\ISF1-1), subframe sync type (P-1\ISF2-1), subframe ID counter location (P-1\IDC1-1;1;), ID counter most significant bit starting bit location (P-1\IDC3-1), ID counter length (P-1\IDC4-1), ID counter transfer order (P-1\IDC5-1), ID counter initial value (P-1\IDC6-1), initial count subframe number (P-1\IDC7-1), ID counter end value (P-1\IDC8-1), end count subframe number (P-1\IDC9-1), and count direction (P-1\IDC10-1) so that I know what the PCM format looks like.

Source reference(s): TMATS Handbook, page 3-4, 3-5, 3-6, 3-7, 3-8

Test case(s): [TC-6](#)

Deficiencies: [D-6](#), [D-7](#), [D-8](#), [D-9](#), [D-10](#), [D-11](#)

3.1.8.1 *PCM Matrix Definition*

- US-12. As a test engineer, I want to be able to define a PCM matrix for storing measurements so that I can efficiently utilize bandwidth.

Source reference(s): TMATS Handbook, Page 2-3

Test case(s): TBD

Deficiencies: N/A

3.1.8.2 *Sample Rate*

- US-13. As a test engineer, I want to be able to define the sampling rate for a given measurement so that I can accurately and efficiently pack measurements into a PCM matrix.

Source reference(s): TMATS Handbook, Page 2-3

Test case(s): TBD

Deficiencies: N/A

3.1.8.3 *Minor Frame Synchronization Pattern*

- US-14. As a test engineer, I want to be able to define a minor frame synchronization pattern for my bit stream so that I can identify the start of the minor frame.

Source reference(s): TMATS Handbook, Page 2-4

Test case(s): TBD

Deficiencies: N/A

3.1.8.4 *Subframe Synchronization Counter*

- US-15. As a test engineer, I want to be able to define a subframe synchronization counter for my bit stream so that I can identify the start of the test data.

Source reference(s): TMATS Handbook, Page 2-4

Test case(s): TBD

Deficiencies: N/A

3.1.8.5 *PCM Major Frame Structure*

- US-16. As a test engineer, I want to be able to describe the structure of a PCM major frame using a name, encoding and data rate (P-1\D1 and P-1\D2), common word length (P-1\F1), transfer order (D-1\MN3), parity (P-1\F3), number of minor frames (P-1\MF\N), length of the minor frame (P-1\MF1 and P-1\MF2; in words and bits, respectively), minor frame sync pattern (P-1\MF3, P-1\MF4, and P-1\MF5), and subframe sync method (P-1\ISF\N, P-1\ISF2, and the ten attributes starting with P-1\IDC) so that the PCM frame can be processed correctly.

Source reference(s): TMATS Handbook, Page 2-7

Test case(s): [TC-8](#)

Deficiencies: None.

3.1.8.6 *PCM Major Frame Contents*

- US-17. As a test engineer, I want to be able to describe the contents (where the measurements are located) of a PCM major frame using the measurement list name (D-1\MLN), the number of measurements (D-1\MN\N) in the major frame, the name that identifies a specific measurement (D-1\MN), parity type (D-1\MN1), location of parity in the measurement (D-1\MN2), measurement transfer order (D-1\MN3-1-1), how to locate the measurement within the major frame (D-1\LT), the number of location definitions (D-1\MML\N), the number of fragments (if any; D-1\MNF\N), word position (D-1\WP), word interval (D-1\W1), frame position (D-1\FP), frame interval (D-1\F1), and bit mask (if any; D-1\WFM) so that the measurements can be extracted from the PCM stream.

Source reference(s): TMATS Handbook, Page 2-7

Test case(s): [TC-9](#)

Deficiencies: [D-12](#)

3.1.8.7 *PCM Word and Frame Pattern*

- US-18. As a test engineer, I want to be able to describe the contents of a PCM major frame using the “word and frame” pattern so that I follow the best practices of the community.

Source reference(s): TMATS Handbook

Test case(s): [TC-9](#)

Deficiencies: None

3.1.8.8 *Location Types*

- US-19. As a test engineer, I want to be able to define the PCM format for storing a measurement so that I know what the measurement is.

Source reference(s): TMATS Handbook, Page 3-10

Test case(s): [TC-10](#)

Deficiencies: None

- US-20. As a test engineer, I want to be able to define where measurements are located in a PCM major frame using fragments, number of measurement location (D-1\MML\N-1-1), number of fragments (D-1\MNF\N-1-1-1), word position (D-1\WP-1-1-1-1), word interval (D-1\WI-1-1-1-1), frame position (D-1\FP-1-1-1-1), and frame interval (D-1\FI-1-1-1-1) so that I know where the measurement is in the PCM frame.

Source reference(s): TMATS Handbook, Page 3-11

Test case(s): [TC-10](#)

Deficiencies: None

3.1.8.8.1 Relative Measurements Pattern

- US-21. As a test engineer, I want to be able to define a packed flag word and individual flag bits that reference it using the “relative measurements” pattern in which a measurement is packed into the same location as another measurement (by referencing that measurement name) using a bit mask so that I can follow the best practices of the community.

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014

Test case(s): TBD

Deficiencies: N/A

- US-22. As a test engineer, I want to be able to define multiple measurements using the TMATS relative location type so that I can refer to the measurements’ location using a name rather than word and frame numbers.

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014

Test case(s): TBD

Deficiencies: N/A

3.1.8.8.2 One Measurement in Exactly One Word Position in Every Minor Frame

- US-23. As a test engineer, I want to be able to describe the contents of a PCM major frame using a minor frame measurement in which the measurement appears in exactly one word position within every minor frame so that I follow the best practices of the community.

Source reference(s): TMATS Handbook, Page 5-2

Test case(s): [TC-11](#)

Deficiencies: [D-13](#)

3.1.8.8.3 Minor Frame Supercommutated Pattern

- US-24. As a test engineer, I want to be able to describe the contents of a PCM major frame using a minor frame supercommutated measurement in which the measurement appears in multiple word positions evenly spaced within every minor frame so that I follow the best practices of the community.

Source reference(s): TMATS Handbook, Page 5-4

Test case(s): [TC-12](#)

Deficiencies: [D-13](#)

- US-25. As a test engineer, I want to be able to describe the contents of a PCM major frame using a minor frame supercommutated measurement in which the measurement appears in multiple word positions unevenly spaced within every minor frame so that I follow the best practices of the community

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014

Test case(s): TBD

Deficiencies: N/A

3.1.8.8.4 Minor Frame Fragmented Pattern

- US-26. As a test engineer, I want to be able to describe the contents of a PCM major frame using a minor frame fragmented measurement in which the measurement spans multiple word positions because its length is greater than the common word length and the fragments appear in exactly one word position within every minor frame so that I follow the best practices of the community.

Source reference(s): TMATS Handbook, Page 5-5

Test case(s): [TC-13](#)

Deficiencies: [D-13](#)

3.1.8.8.5 Subcommutated Measurement Pattern

- US-27. As a test engineer, I want to be able to describe the contents of a PCM major frame using a subcommutated measurement in which the measurement appears in exactly one word position within exactly one minor frame of the major frame so that I follow the best practices of the community.

Source reference(s): TMATS Handbook, Page 5-7

Test case(s): [TC-14](#)

Deficiencies: [D-13](#)

3.1.8.8.6 Supersubcommutated Measurement Pattern

- US-28. As a test engineer, I want to be able to describe the contents of a PCM major frame using a subframe supercommutated (supersubcommutated) measurement in which the measurement appears in multiple frame positions evenly spaced within exactly one word position so that I follow the best practices of the community.

Source reference(s): TMATS Handbook, Page 5-8

Test case(s): [TC-15](#)

Deficiencies: [D-13](#)

3.1.8.8.7 *Fragmented Subcommutated Measurement Pattern*

- US-29. As a test engineer, I want to be able to describe the contents of a PCM major frame using a fragmented subcommutated measurement in which the measurement spans multiple word positions because its length is greater than the common word length and each of its fragments appears in exactly one word position within exactly one minor frame so that I follow the best practices of the community.

Source reference(s): TMATS Handbook, Page 5-9

Test case(s): [TC-15](#)

Deficiencies: [D-13](#)

3.1.8.8.8 *Fragmented Supersubcommutated Measurement Pattern*

- US-30. As a test engineer, I want to be able to describe the contents of a PCM major frame using a fragmented subframe supercommutated (supersubcommutated) measurement in multiple unevenly spaced locations in which the measurement spans multiple word positions because its length is greater than the common word length (fragmented) and each of its fragments appears in multiple word position anywhere in the minor frame so that I can fit aperiodic data into a periodic PCM stream.

Source reference(s): TMATS Handbook, Page 5-10, Figures 5-7 and 5-8

Test case(s): [TC-16](#)

Deficiencies: [D-13](#)

3.1.8.8.9 *Fragmented Supercommutated Measurement Pattern*

- US-31. As a test engineer, I want to be able to describe the contents of a PCM major frame using a minor frame fragmented and supercommutated measurement in which the measurement spans multiple word positions because its length is greater than the common word length and the fragments appear in multiple word positions within every minor frame so that I can achieve a higher sample rate than the minor frame rate.

Source reference(s): TMATS Handbook, Page 5-17

Test case(s): [TC-17](#)

Deficiencies: [D-13](#)

3.1.8.9 *Concatenation*

- US-32. As a test engineer, I want to be able to use concatenation to fit measurements that are larger than the common word length into multiple word locations where not all bits in a word are used, so that I follow the best practices of the community.

Source reference(s): TMATS Handbook, Page 5-20

Test case(s): TBD

Deficiencies: [D-14](#)

3.1.8.10 *Multiple Measurements in a Single Word Location*

- US-33. As a test engineer, I want to have multiple measurements in a single word location, using bitmasks, because the measurements occupy fewer bits than the common word length, so that I can preserve PCM space.

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014

Test case(s): TBD

Deficiencies: N/A

3.1.8.11 *Two Measurements in Same Location with Different EU Conversions*

- US-34. As a test engineer, I want to define two measurements in the same location with two different engineering unit conversions (e.g. temp F, temp C), so that I can conveniently display the same measurement in different units.

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014

Test case(s): TBD

Deficiencies: N/A

3.1.8.12 *Multiple Embedded PCMs*

- US-35. As a test engineer, I want to capture the telemetry format (PCM) for a weapons system that defines multiple embedded PCMs.

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014

Test case(s): TBD

Deficiencies: N/A

3.1.8.13 *Asynchronous Embedded Format with Fixed Bit Rate*

- US-36. As a test engineer, I want to capture an asynchronous supercommutated or subcommutated embedded format with a fixed bit rate so that I can multiplex multiple data streams on a single transmitter.

Source reference(s): Chapter 9⁶, page 9-53

Test case(s): TBD

Deficiencies: N/A

⁶ Range Commanders Council. "Telemetry Attributes Transfer Standard," in *Telemetry Standards*. IRIG 106-15. July 2015. May be superseded by update. Retrieved 1 July 2015. Available at http://www.wsmr.army.mil/RCCsite/Documents/106-15_Telemetry_Standards/Chapter9.pdf

3.1.8.14 *Asynchronous Data Merge Format*

- US-37. I want to capture an asynchronous supercommutated or subcommutated data merge format with overhead bits so that I can merge in a sub-format with a variable bit rate.

Source reference(s): Chapter 9, page 9-51

Test case(s): TBD

Deficiencies: N/A

3.1.9 Measurements

This section defines user stories for describing TMATS measurements.

3.1.9.1 *Measurement Definition*

- US-38. As a test engineer, I want to define the measurements for placing into a PCM frame so that the test measurements are recorded.

Source reference(s): TMATS Handbook, Page 3-9.

Test case(s): [TC-9](#), [TC-10](#), [TC-11](#), [TC-12](#), [TC-13](#), [TC-14](#), [TC-15](#), [TC-16](#), [TC-17](#)

Deficiencies: None

- US-39. As a test engineer, I want to be able to define the data for a measurement including a name, parity (D-1\MN1-1-1), measurement transfer order (D-1\MN3-1-1), measurement location type (D-1\LT-1-1), bit mask so that I know what the measurement is.

Source reference(s): TMATS Handbook, Page 3-10.

Test case(s): [TC-9](#), [TC-10](#), [TC-11](#), [TC-12](#), [TC-13](#), [TC-14](#), [TC-15](#), [TC-16](#), [TC-17](#)

Deficiencies: None

- US-40. As a test engineer, I want to be able to define that data that describes the test measurements including data link name (D-1\DLN) and number of measurements for the test measurements (D-1\ML\N) so that I know what data is to be collected.

Source reference(s): TMATS Handbook, Page 3-9.

Test case(s): [TC-9](#), [TC-10](#), [TC-11](#), [TC-12](#), [TC-13](#), [TC-14](#), [TC-15](#), [TC-16](#), [TC-17](#)

Deficiencies: None

3.1.9.2 *Measurement Lists*

- US-41. As a test engineer, I want to be able to define a measurement list so that I can organize the test measurements.

Source reference(s): TMATS Handbook, Page 3-9.

Test case(s): [TC-9](#), [TC-10](#), [TC-11](#), [TC-12](#), [TC-13](#), [TC-14](#), [TC-15](#), [TC-16](#), [TC-17](#)

Deficiencies: None

- US-42. As a test engineer, I want to be able to define the data for a measurement list including a name (D-1\MLN-1) and the number of measurements in the list (D-1\MN\N-1) so I know what the measurement list is.

Source reference(s): TMATS Handbook, Page 3-9.

Test case(s): [TC-9](#), [TC-10](#), [TC-11](#), [TC-12](#), [TC-13](#), [TC-14](#), [TC-15](#), [TC-16](#), [TC-17](#)

Deficiencies: [D-15](#)

- US-43. As a test engineer, I want to be able to define the measurements in the measurement list so that I know what data is being collected.

Source reference(s): TMATS Handbook, Page 3-10.

Test case(s): [TC-9](#), [TC-10](#), [TC-11](#), [TC-12](#), [TC-13](#), [TC-14](#), [TC-15](#), [TC-16](#), [TC-17](#)

Deficiencies: None

- US-44. As a test engineer, I want to be able to define a measurement list change where the format does not change but the contents of the format change during transmission.

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014.

Test case(s): TBD

Deficiencies: N/A

- US-45. As a test engineer, I want to be able to define a format change where the shape, content, and bit rate of the format change during transmission.

Source reference(s): Face-to-face meeting at Edwards Air Force Base, April 2014.

Test case(s): TBD

Deficiencies: N/A

3.1.10 Data Conversion

- US-46. As a test engineer, I want to define a method for converting raw telemetry bits to engineering units so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-18](#)

Deficiencies: [D-16](#)

- US-47. As a test engineer, I want to be able to define the data that defines the conversion method including the measurement name (C-1\DCN) to link to the measurement list, a description of the measurement (C-1\MN1), the binary format (C-1\BFM) of the

measurement, and data conversion (C-x\DCT) of the measurement in the PCM stream so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12, 3-13.

Test case(s): [TC-18](#)

Deficiencies: None

- US-48. As a test engineer, the type of data conversion method I want to use is Pair Sets (example: C-1\DCT:PRS) so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-19](#)

Deficiencies: [D-17](#)

- US-49. As a test engineer, I want to be able to use Coefficients as the conversion method (example: C-1\DCT:COE) including the order of the polynomial curve fit, the 0th coefficient, and the nth coefficient so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12, 3-13.

Test case(s): [TC-20](#)

Deficiencies: None

- US-50. As a test engineer, I want to be able to define a negative powers of X coefficients conversion method so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): TBD

Deficiencies: N/A

- US-51. As a test engineer, the type of data conversion method I want to use is Derived (example: C-1\DCT:DER) so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-21](#)

Deficiencies: [D-18](#)

- US-52. As a test engineer, I want to be able to define Discrete as the conversion method (example: C-1\DCT:DIS) so that I can map discrete values to text strings.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-22](#)

Deficiencies: None.

- US-53. As a test engineer, I want to be able to use PCM as the time conversion method (example: C-1\DCT:PTM) so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-23](#)

Deficiencies: None.

- US-54. As a test engineer, the conversion method I want to use is 1553 (example: C-1\DCT:BTM) so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-24](#)

Deficiencies: None.

- US-55. As a test engineer, I want to be able to use Digital Voice as the conversion method (example: C-1\DCT:VOI) so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-25](#)

Deficiencies: None.

- US-56. As a test engineer, I want to use Digital Video as the conversion method (example: C-1\DCT:VID) so that I can process video embedded in a PCM stream.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-26](#)

Deficiencies: [D-19](#)

- US-57. As a test engineer, the conversion method I want to use is Special Processing (example: C-1\DCT:SP) so that I can analyze test data.

Source reference(s): TMATS Handbook, Page 3-12.

Test case(s): [TC-27](#)

Deficiencies: [D-20](#)

3.1.11 Transmission

- US-58. As a test engineer, I want to be able to define the data for describing the RF source so that the transmitter can accurately transmit the PCM data to the ground station antenna, receiver, and recording device.

Source reference(s): TMATS Handbook, Page 5-25.

Test case(s): [TC-28](#)

Deficiencies: None

- US-59. As a test engineer, I want to be able to define the data to set up the ground station so that it can receive the RF signal.

Source reference(s): TMATS Handbook, Page 5-25.

Test case(s): [TC-28](#)

Deficiencies: None

3.1.12 Recording

- US-60. As an instrumentation engineer, I want to be able to extract the measurements recorded during a test.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-61. As an instrumentation engineer, I want to be able to set up the recorder to record the data on the ground and on-board the test article.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-62. As an instrumentation engineer, I want to be able to set up the recorder to record the following data types: “PCMIN” (PCM Input), “VIDIN” (Video Input), “ANAIN” (Analog Input), “1553IN” (1553 Input), “DISIN” (Discrete Input), “TIMEIN” (IRIG Time Input), “UARTIN” (UART Input), “429IN” (ARINC 429 Input), “MSGIN” (Message Data Input), “IMGIN” (Image Data Input), “1394IN” (IEEE-1394 Input), “PARIN” (Parallel Input), “ETHIN” (Ethernet Input), “TSPIN” (TSPI/CTS Input), and “CANIN” (CAN bus Input).

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-63. As an instrumentation engineer, I want to be able to set up recorder settings.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-64. As an instrumentation engineer, I want to be able to enable indices.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

US-65. As an instrumentation engineer, I want to be able to set up events and triggers.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

US-66. As an instrumentation engineer, I want to be able to set up filters to filter the data recorded to the device.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2 IHAL

This section describes the high-level IHAL XML schema validation user stories.

US-67. As an instrumentation engineer, I want to be able to record the data on the ground and on-board the test article.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.1 IHAL Signal Conditioning

US-68. As an instrumentation engineer, I want to configure devices to perform analog signal conditioning.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

US-69. As an instrumentation engineer, I want to configure signal conditioning to (optimally) match the signal source with the data acquisition system.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-70. As an instrumentation engineer, I want to configure an analog signal conditioning device to perform amplification, attenuation, filtering, zero shifting, and compensation.
- Source reference(s): Committee Feedback
- Test case(s): TBD
- Deficiencies: N/A
- US-71. As an instrumentation engineer, I want to configure frequency filtering so that I transmit wanted and attenuate unwanted frequency content in the measurement signal so that I can reduce the amount of noise outside the data bandwidth and can select certain frequency bands.
- Source reference(s): Committee Feedback
- Test case(s): TBD
- Deficiencies: N/A
- US-72. As an instrumentation engineer, I want to configure a low-pass filter to pass frequencies below a cut-off value.
- Source reference(s): Committee Feedback
- Test case(s): TBD
- Deficiencies: N/A
- US-73. As an instrumentation engineer, I want to configure a high-pass filter to pass frequencies above a cut-off value.
- Source reference(s): Committee Feedback
- Test case(s): TBD
- Deficiencies: N/A
- US-74. As an instrumentation engineer, I want to configure a band-pass filter to pass frequencies within a given band.
- Source reference(s): Committee Feedback
- Test case(s): TBD
- Deficiencies: N/A
- US-75. As an instrumentation engineer, I want to configure a band-reject filter to reject frequencies within a given band.
- Source reference(s): Committee Feedback
- Test case(s): TBD
- Deficiencies: N/A

3.2.2 IHAL Temperature Measurement

- US-76. As an instrumentation engineer, I want to collect and store temperatures on the test article so that I can validate performance of the test.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-77. As an instrumentation engineer, I want to configure a telemetry system for transmitting temperature measurements so that I can send measurements to a recorder or ground station.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-78. As an instrumentation engineer, I want to be able to set up filters to filter the data recorded to the device.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-79. As an instrumentation engineer, I want to perform signal conditioning on temperature measurements.

Source reference(s): Committee Feedback

Test case(s): [TC-29](#)

Deficiencies: [D-22](#), [D-23](#)

- US-80. As an instrumentation engineer, I want to sample temperature at very low rates so that I can make the best use of transmission bandwidth (temperature changes at low rates).

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-81. As an instrumentation engineer, I want to measure engine air intake temperature.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-82. As an instrumentation engineer, I want to measure temperature with a device that can operate within the expected temperature ranges (local climate and normal operating range) so that I can have access to temperature ranges at and around the test center.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.2.1 *Thermocouples*

- US-83. As an instrumentation engineer, I want to be able to use several different types and styles of thermocouples on the same test article so that I can have advanced knowledge of the expected range of temperatures and the environment in which the measurement is to be made.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

- US-84. As an instrumentation engineer, I want to measure engine intake air temperature using a T-type thermocouple.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.3 Bus Monitor Configuration

- US-85. As an instrumentation engineer, I want to monitor data buses for test item information so that I can record and stream test item data.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.3.1 *ARINC-429 Bus Monitor Configuration*

- US-86. As an instrumentation engineer, I want to be able to set up an ARINC-429 bus monitor to parse/filter specific messages by label and SSM values and specify the measurements to be read from these filtered messages so that my test requirements are met.

Source reference(s): IHAL feedback from Curtiss-Wright Corporation

Test case(s): [TC-30](#)

Deficiencies: [D-24](#), [D-25](#), [D-26](#)

3.2.3.2 *MIL-STD-1553 Bus Monitor Configuration*

- US-87. As an instrumentation engineer, I want to be able to set up a MIL-STD-1553 bus monitor to parse/filter specific messages and specify the measurements to be read from these filtered messages so that my test requirements are met.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.3.3 *PCM Stream Monitor Configuration*

- US-88. As an instrumentation engineer, I want to be able to set up a PCM stream monitor to parse/filter specific messages and specify the measurements to be read from these filtered messages so that my test requirements are met.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.4 Data Stream Encoder Configuration

- US-89. As an instrumentation engineer, I want to be able to store a measurement collected during a test to a data stream using a data encoder so that my test requirements are met.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.4.1 *PCM Encoder Configuration*

- US-90. As an instrumentation engineer, I want to be able to store a measurement collected during a test to a PCM frame via a PCM encoder so that my test requirements are met.

Source reference(s): Committee Feedback

Test case(s): [TC-31](#)

Deficiencies: [D-27](#), [D-28](#)

3.2.4.2 *TmNS Data Encoder Configuration*

- US-91. As an instrumentation engineer, I want to be able to store a measurement collected during a test to an integrated Network Enhanced Telemetry (iNET) telemetry network system (TmNS) message via an iNET network data encoder so that my test requirements are met.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.2.4.3 *Generic Network Data Encoder Configuration*

- US-92. As an instrumentation engineer, I want to be able to store a measurement collected during a test to a generic network message via a network data encoder so that my test requirements are met.

Source reference(s): Committee Feedback

Test case(s): TBD

Deficiencies: N/A

3.3 DDML

This section describes the high-level DDML XML schema validation user stories.

3.3.1 General DDML User Stories

- US-93. As a data analyst, I want to be able to use graphic resources to display data so that the data can be visualized and analyzed.

Source reference(s)

Test case(s): [TC-36](#), [TC-37](#), [TC-38](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-94. As a data analyst, I want to retrieve data from multiple data sources so that data is not limited to a single source and more data can be displayed.

Source reference(s)

Test case(s): [TC-36](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-95. As a data analyst, I want to store data in data variables so that data can be utilized in software.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

- US-96. As a data analyst, I want to derive new data from existing data sets so that I can gain new insights into the data.

Source reference(s)

Test case(s): [TC-44](#)

Deficiencies: N/A

- US-97. As a data analyst, I want to dynamically update data displays so that I can show real-time data.

Source reference(s)

Test case(s): [TC-36](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-98. As a data analyst, I want to use multiple colors so that users can easily decipher different elements.

Source reference(s)

Test case(s): [TC-36](#), [TC-37](#), [TC-38](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-99. As a data analyst, I want to position graphics so that they can adequately present data.

Source reference(s)

Test case(s): [TC-36](#), [TC-37](#), [TC-38](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-100. As a data analyst, I want to combine low-level graphic elements (lines, rectangles, etc.) so that I can build complex graphics.

Source reference(s)

Test case(s): [TC-38](#)

Deficiencies: N/A

- US-101. As a data analyst, I want to use Scalable Vector Graphics (SVG) so that I can support interactivity and animations.

Source reference(s)

Test case(s): [TC-38](#), [TC-43](#)

Deficiencies: N/A

- US-102. As a data analyst, I want to use a project structure to store data display information so that various configurations and displays can be created.

Source reference(s)

Test case(s): [TC-32](#)

Deficiencies: N/A

- US-103. As a data analyst, I want storage of data history so that previously collected data can be shown using data displays.

Source reference(s)

Test case(s): [TC-33](#)

Deficiencies: N/A

3.3.2 Data Display Object Containers

- US-104. As a data analyst, I want graphs to specify data display configurations so that the data can be interpreted and analyzed.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-105. As a data analyst, I want graph titles to display a general statement of what the graph is displaying so that context can be given to the graph data.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-106. As a data analyst, I want to set graph title color, font, and size so that the graph title is visually appealing.

Source reference(s)

Test case(s): [TC-39](#)

Deficiencies: N/A

- US-107. As a data analyst, I want to set background and data area colors for graphs so that I can differentiate different data areas.

Source reference(s)

Test case(s): [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-108. As a data analyst, I want grids to display a group of display objects in a tabular layout so that display objects can be evenly spaced.

Source reference(s)

Test case(s): [TC-45](#)

Deficiencies: N/A

US-109. As a data analyst, I want to specify grid row and column for display objects so that objects can be placed in specific cells of a grid.

Source reference(s)

Test case(s): [TC-45](#)

Deficiencies: N/A

US-110. As a data analyst, I want to show or hide gridlines so that the grid cells can be outlined or not outlined.

Source reference(s)

Test case(s): N/A

Deficiencies: [D-31](#)

US-111. As a data analyst, I want color assignments for gridlines so that they can indicate different connected elements of the grid.

Source reference(s)

Test case(s): N/A

Deficiencies: [D-32](#)

US-112. As a data analyst, I want models to store graphic resource configurations and processes so that they can be stored and reused.

Source reference(s)

Test case(s): [TC-35](#)

Deficiencies: N/A

US-113. As a data analyst, I want to specify whether a model needs to be displayed or referenced so that only the necessary data displays will be shown.

Source reference(s)

Test case(s): [TC-35](#)

Deficiencies: N/A

US-114. As a data analyst, I want to set x and y directions so that model orientation can be configured.

Source reference(s)

Test case(s): [TC-35](#)

Deficiencies: N/A

US-115. As a data analyst, I want to reference sub-models so that existing models can be used within new container models.

Source reference(s)

Test case(s): [TC-43](#)

Deficiencies: N/A

- US-116. As a data analyst, I want maps to display geographical information so that geospatial information can be understood.

Source reference(s)

Test case(s): [TC-37](#)

Deficiencies: N/A

- US-117. As a data analyst, I want to choose a minimum and maximum value for longitude and latitude so that a specific geospatial area can be shown.

Source reference(s)

Test case(s): [TC-37](#)

Deficiencies: [D-30](#)

- US-118. As a data analyst, I want the option to choose a map image file so that a map image can be used as the map.

Source reference(s)

Test case(s): [TC-37](#)

Deficiencies: N/A

3.3.3 Common Data Display Object Elements

3.3.3.1 *Axis*

- US-119. As a data analyst, I want axes to display values or times for plots so that plot data can be interpreted.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-120. As a data analyst, I want color assignments for axes so that multiple axes can be differentiated.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-121. As a data analyst, I want a label for each axis so that the data values can be interpreted.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

US-122. As a data analyst, I want to set label font size and style so that font can easily be read.

Source reference(s)

Test case(s): [TC-46](#)

Deficiencies: N/A

US-123. As a data analyst, I want to specify minimum and maximum axis values so that the axis can be bound.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

US-124. As a data analyst, I want to set the axis unit so that context can be given to the displayed values.

Source reference(s)

Test case(s): [TC-40](#)

Deficiencies: N/A

US-125. As a data analyst, I want axis grids so that data values on plots can be accurately estimated.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#)

Deficiencies: N/A

US-126. As a data analyst, I want axis grid intervals so that data granularity can be increased or decreased.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#)

Deficiencies: N/A

US-127. As a data analyst, I want the ability to show or hide axis ticks so that precise data values can be accurately estimated.

Source reference(s)

Test case(s): [TC-46](#)

Deficiencies: N/A

US-128. As a data analyst, I want to specify tick color so that emphasis can be given to the ticks.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#)

Deficiencies: N/A

US-129. As a data analyst, I want tick labels so that the value of each tick is shown.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#)

Deficiencies: N/A

US-130. As a data analyst, I want to specify tick label font size and style so that the labels can be read easily.

Source reference(s)

Test case(s): [TC-46](#)

Deficiencies: N/A

US-131. As a data analyst, I want to set tick label intervals so that labels are only shown on the specific tick intervals.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#)

Deficiencies: N/A

US-132. As a data analyst, I want to set the axis type to either VALUE or TIME so that context can be given to the axis.

Source reference(s)

Test case(s): [TC-39](#), [TC-40](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

3.3.3.2 *Colors*

US-133. As a data analyst, I want colors for all data display objects so that data displays can be visually appealing.

Source reference(s)

Test case(s): [TC-32](#), [TC-33](#), [TC-36](#), [TC-38](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-134. As a data analyst, I want base-10 integer encoding for colors so that a common storage mechanism can be used for all color assignments.

Source reference(s)

Test case(s): [TC-32](#), [TC-33](#), [TC-36](#), [TC-38](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

3.3.4 Data Display Objects

3.3.4.1 *Bar Charts*

- US-135. As a data analyst, I want bar charts to display one or more variables as vertical or horizontal bars whose lengths correspond to the values so that data can be analyzed and compared.

Source reference(s)

Test case(s): [TC-39](#)

Deficiencies: N/A

- US-136. As a data analyst, I want color assignments for bar charts so that they can indicate different data sets being shown in the bar chart.

Source reference(s)

Test case(s): [TC-37](#)

Deficiencies: N/A

- US-137. As a data analyst, I want to specify bar chart scroll direction so that the bars will be oriented and extend toward the direction.

Source reference(s)

Test case(s): [TC-37](#)

Deficiencies: N/A

3.3.4.2 *Buttons*

- US-138. As a data analyst, I want buttons to perform variable assignments on a user click so that users can dynamically change data displays.

Source reference(s)

Test case(s): [TC-41](#)

Deficiencies: N/A

- US-139. As a data analyst, I want color assignments for buttons so that button functions can be emphasized.

Source reference(s)

Test case(s): [TC-41](#)

Deficiencies: [D-34](#)

- US-140. As a data analyst, I want to set a label for a button so that meaning can be given to the button.

Source reference(s)

Test case(s): [TC-41](#)

Deficiencies: N/A

- US-141. As a data analyst, I want color assignments for button labels so that emphasis can be given to the button.

Source reference(s)

Test case(s): [TC-41](#)

Deficiencies: N/A

- US-142. As a data analyst, I want to set button label font and size so that the button can be customized.

Source reference(s)

Test case(s): [TC-41](#)

Deficiencies: N/A

3.3.4.3 *Custom Display Objects*

- US-143. As a data analyst, I want to build non-standardized display objects so that unique data displays can be created.

Source reference(s)

Test case(s): [TC-38](#)

Deficiencies: N/A

- US-144. As a data analyst, I want to utilize one or more existing display objects, as well as other graphic resources, in a custom data display object so that complex custom data displays can be designed using existing data displays.

Source reference(s)

Test case(s): [TC-38](#)

Deficiencies: N/A

3.3.4.4 *Dials*

US-145. As a data analyst, I want dials to display circular axis values so that I can create a gauge or compass.

Source reference(s)

Test case(s): [TC-42](#)

Deficiencies: N/A

US-146. As a data analyst, I want to assign colors to dials so that emphasis can be given to the dials.

Source reference(s)

Test case(s): [TC-42](#)

Deficiencies: N/A

US-147. As a data analyst, I want to set minimum and maximum dial angles so that the dial range can be restricted.

Source reference(s)

Test case(s): [TC-42](#)

Deficiencies: N/A

3.3.4.5 *Frequency Plots*

US-148. As a data analyst, I want frequency plots to display frequency vs. magnitude so that frequencies can be analyzed.

Source reference(s)

Test case(s): [TC-40](#)

Deficiencies: N/A

US-149. As a data analyst, I want frequency plotted on the *x*-axis and magnitude plotted on the *y*-axis so that the data can be visualized.

Source reference(s)

Test case(s): [TC-40](#)

Deficiencies: N/A

US-150. As a data analyst, I want color assignments for frequency plots so that emphasis can be given to the frequency plots.

Source reference(s)

Test case(s): [TC-40](#)

Deficiencies: N/A

3.3.4.6 *Frequency Response Plots*

- US-151. As a data analyst, I want frequency response plots to display magnitude and phase on the same frequency axis so that the signal can be analyzed.

Source reference(s)

Test case(s): [TC-49](#)

Deficiencies: N/A

- US-152. As a data analyst, I want color assignments for frequency response plots so that emphasis can be given to the frequency response plots.

Source reference(s)

Test case(s): [TC-49](#)

Deficiencies: N/A

3.3.4.7 *Heads-Up Displays*

- US-153. As a data analyst, I want heads-up displays (HUDs) to project display objects onto transparent surfaces so that data can be displayed without requiring users to look away.

Source reference(s)

Test case(s): [TC-43](#)

Deficiencies: N/A

- US-154. As a data analyst, I want to specify text color, size, and font for HUDs so that textual information can be readable when overlaid on a video feed.

Source reference(s)

Test case(s): [TC-43](#)

Deficiencies: N/A

3.3.4.8 *Pie Charts*

- US-155. As a data analyst, I want pie charts to display multiple percentage variables in a circular form so that percentages can be adequately visualized.

Source reference(s)

Test case(s): [TC-44](#)

Deficiencies: N/A

- US-156. As a data analyst, I want color assignments for pie charts so that data sets can be differentiated.

Source reference(s)

Test case(s): [TC-44](#)

Deficiencies: N/A

3.3.4.9 *Radial Charts*

US-157. As a data analyst, I want radial charts to display objects that represent values as distances outward from a central point so that I can better understand the data.

Source reference(s)

Test case(s): [TC-48](#)

Deficiencies: N/A

US-158. As a data analyst, I want color assignments for radial charts so that emphasis can be given to the charts.

Source reference(s)

Test case(s): [TC-48](#)

Deficiencies: N/A

3.3.4.10 *Sliders*

US-159. As a data analyst, I want sliders to allow users to dynamically change the data being displayed so that users can identify the specific data they would like to view.

Source reference(s)

Test case(s): [TC-45](#)

Deficiencies: N/A

US-160. As a data analyst, I want color assignments for sliders so that emphasis can be given.

Source reference(s)

Test case(s): [TC-45](#)

Deficiencies: N/A

US-161. As a data analyst, I want to set slider orientation so that the slider can be either vertical or horizontal.

Source reference(s)

Test case(s): [TC-45](#)

Deficiencies: N/A

3.3.4.11 *Strip Charts*

US-162. As a data analyst, I want strip charts to display plots on a scrolling grid so that data can be dynamically displayed.

Source reference(s)

Test case(s): [TC-46](#)

Deficiencies: N/A

US-163. As a data analyst, I want color assignments for strip charts so that they can indicate different data sets displayed by the strip chart.

Source reference(s)

Test case(s): [TC-46](#)

Deficiencies: N/A

US-164. As a data analyst, I want to specify strip chart scroll direction so that the strip chart will be oriented and extend towards the scroll direction.

Source reference(s)

Test case(s): [TC-46](#)

Deficiencies: N/A

3.3.4.12 *Text*

US-165. As a data analyst, I want to display text objects so that information can be passed textually to a user.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

US-166. As a data analyst, I want to display both static and dynamic text so that context can be given to various graphical elements.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

US-167. As a data analyst, I want colored text so that significance/context can be given to text.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

US-168. As a data analyst, I want a selection of text fonts so that the appearance of the text can be changed.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

US-169. As a data analyst, I want to set text size so that emphasis can be given to text.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

US-170. As a data analyst, I want to set text alignment so that the position of the text can be automatically calculated.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

US-171. As a data analyst, I want to set text position so that I can set the exact location of the text.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

US-172. As a data analyst, I want to specify the background color of text objects so that contrast can be given to the text color.

Source reference(s)

Test case(s): [TC-36](#)

Deficiencies: N/A

3.3.4.13 *XY Charts*

US-173. As a data analyst, I want *xy* charts to display a line or scatter plot on an *x* and *y* axis so that I can visualize a set of *xy* pairs.

Source reference(s)

Test case(s): [TC-47](#)

Deficiencies: N/A

- US-174. As a data analyst, I want axis objects to have a type of either VALUE or TIME so that I can better understand the use for the axis.

Source reference(s)

Test case(s): [TC-47](#)

Deficiencies: N/A

- US-175. As a data analyst, I want color assignments for xy charts so that they can be differentiated.

Source reference(s)

Test case(s): [TC-47](#)

Deficiencies: N/A

3.3.5 Dynamics

- US-176. As a data analyst, I want to use greater-than, less-than, greater-than-or-equal, less-than-or-equal, equal, and not equal comparison operators so that two objects can be compared.

Source reference(s)

Test case(s): [TC-36](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-177. As a data analyst, I want comparisons between two objects so that I can perform further operations based on the results.

Source reference(s)

Test case(s): [TC-36](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-178. As a data analyst, I want built-in display object dynamic behaviors so that display object functionality can be easily implemented.

Source reference(s)

Test case(s): [TC-36](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-179. As a data analyst, I want display object scaling so that display objects can resize during run time.

Source reference(s)

Test case(s): [TC-36](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-180. As a data analyst, I want if, then, and else rule types so that object manipulations can be made based on object value(s) or state(s).

Source reference(s)

Test case(s): [TC-36](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-181. As a data analyst, I want functions so that data variables can be manipulated or created based on a given set of inputs.

Source reference(s)

Test case(s): [TC-44](#)

Deficiencies: N/A

- US-182. As a data analyst, I want to be able to rotate the object so that the user can gain a better perspective.

Source reference(s)

Test case(s): TBD

Deficiencies: N/A

- US-183. As a data analyst, I want to move display objects in the *x* or *y* planes so that the objects can be placed in desired locations.

Source reference(s)

Test case(s): [TC-36](#), [TC-37](#), [TC-39](#), [TC-40](#), [TC-41](#), [TC-42](#), [TC-43](#), [TC-44](#), [TC-45](#), [TC-46](#), [TC-47](#), [TC-48](#)

Deficiencies: N/A

- US-184. As a data analyst, I want to change the color of the display object based on an event so that events can be visualized or meaning can be given to an event.

Source reference(s)

Test case(s): [TC-38](#)

Deficiencies: N/A

- US-185. As a data analyst, I want display object visibility to change so that objects can be shown or hidden.

Source reference(s)

Test case(s): N/A

Deficiencies: [D-33](#)

- US-186. As a data analyst, I want logical operators (AND, OR, or XOR) so that data variable manipulations can occur when certain conditions are met.

Source reference(s)

Test case(s): [TC-44](#)

Deficiencies: N/A

- US-187. As a data analyst, I want to use mathematical operators so that data can be manipulated.

Source reference(s)

Test case(s): [TC-44](#)

Deficiencies: N/A

3.3.6 Data Variables

- US-188. As a data analyst, I want data variables so that objects and data sources can be linked.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

- US-189. As a data analyst, I want data variable types so that objects can store different sets of information.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

- US-190. As a data analyst, I want a data variable pool so that all variables are enumerated and can be accessed.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

- US-191. As a data analyst, I want to store incoming data in data variables so that I can utilize the data in software.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

US-192. As a data analyst, I want to store a set of related information so that I can retrieve the information when necessary.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

US-193. As a data analyst, I want data variable instances so that I can use the variable.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

US-194. As a data analyst, I want static value data variables so that static information can be stored and accessed.

Source reference(s)

Test case(s): [TC-34](#)

Deficiencies: N/A

3.3.7 Data Sources

US-195. As a data analyst, I want data sources to store or transmit data so that the data can be stored in data variables.

Source reference(s)

Test case(s): [TC-33](#)

Deficiencies: N/A

US-196. As a data analyst, I want a data source pool so that data sources can be selected and used.

Source reference(s)

Test case(s): [TC-33](#)

Deficiencies: N/A

US-197. As a data analyst, I want an unbounded parameter to specify pertinent data source information so that unique data source information can be enumerated.

Source reference(s)

Test case(s): [TC-33](#)

Deficiencies: N/A

US-198. As a data analyst, I want to utilize various data source types so that data can be retrieved from multiple data source types.

Source reference(s)

Test case(s): [TC-33](#)

Deficiencies: N/A

US-199. As a data analyst, I want to specify the data source type so that data source features can be inferred based on type.

Source reference(s)

Test case(s): [TC-33](#)

Deficiencies: N/A

4. Test Cases

This section lists all of the test cases currently developed under this effort. Each test case consists of a human-readable description of a specific example scenario, a reference to the user story the test case is an example of, and a reference to a valid XML instance document that implements the test case.

4.1 TMATS-XML

TC-1. TMATS Metadata Description

Details: Define the metadata for a TMATS file.

- Program name: Schema validation task
- Test item: Test article metadata
- Origination date: 2014-02-03
- POC: Wile E. Coyote, ACME Corp, 123 Roadrunner Way, (555) 555-5555
- Data source type: RF
- Data source name: RF_DATA_SOURCE
- Data source security classification: Unclassified
- Security classification: Unclassified

Instance Document: tmats-metadata-test-case-001.xml

Relevant User Stories: [US-4](#)

Deficiencies: [D-1](#), [D-2](#)

TC-2. TMATS RF Data Link Description

Details: Define the metadata for an RF data source.

- Metadata is as in [TC-1](#)
- Transmission attributes source RF attributes frequency: 2251.5
- Transmission attributes source RF attributes modulation type: FM

Instance Document: rf-data-link-test-case-001.xml

Relevant User Stories: [US-5](#)

Deficiencies: [D-3](#)

TC-3. TMATS Multiplex Waveform Description

Details: Define the metadata for a multiplex waveform.

- Metadata is as in [TC-1](#)
- Multiplex modulation group baseband signal type: PCM
- Multiplex modulation group baseband signal data link name: PCM stream
- Data source data link name: PCM stream

Instance Document: multiplex-waveform-test-case-001.xml

Relevant User Stories: [US-6](#)

Deficiencies: [D-3](#)

TC-4. Linking TMATS T-Group, R-Group, and M-Group

Details: Define the linkages between a T-Group, R-Group, and M-Group.

- First data source type: RF
- First data source name: SOURCE1
- First data source transmission attributes TMATS version: 106-13
- First data source multiplex modulation group TMATS version: 106-13
- Second data source type: RF
- Second data source name: SOURCE2
- Second data source recorder reproducer attributes TMATS version: 106-13
- Second data source multiplex modulation group TMATS version: 106-13

Instance Document: trm-group-linking-test-case-001.xml

Relevant User Stories: [US-7](#)

Deficiencies: [D-3](#)

TC-5. Linking TMATS PCM frame, M-Group, and measurement

Details: Define the linkages between a PCM frame, M-Group, and measurement.

- Data source type: RF
- Data source name: RF_DATA_SOURCE
- Data source multiplex modulation group baseband signal data link name: PCM_STREAM
- Data source data link name: PCM_STREAM
- Data source data link PCM format attributes PCM measurements measurement list measurement name M1

Instance Document: pcm-m-group-measurement-linking-test-case-001.xml

Relevant User Stories: [US-9](#)

Deficiencies: [D-5](#), [D-21](#)

TC-6. Linking R group, P group, M group, and measurement list

Details: Define the linkages between an R group, P group, and measurement list.

- Data source type: RF
- Data source name: RF data source
- Data source recorder reproducer attributes data 1 channel data link name: DL 2
- Data source recorder reproducer attributes data 2 ARINC 429 bus data type attributes sub channel name: DL 1
- Data source recorder reproducer attributes data 3 UART data type attributes sub channel name: DL 1
- Data source recorder reproducer attributes data 4 message data type attributes sub channel name: DL 2
- Data source recorder reproducer attributes data 5 Ethernet data type attributes network name: DL 2
- Data source multiplex modulation group baseband signal data link name: DL 1
- Data source multiplex modulation group subcarriers IRIG subcarrier data link name: DL 2
- Data source data link1 name: DL 1
- Data source data link 2 name: DL 2
- Data source data link 2 PCM format attributes format change measurement list change measurement list name: ML 1
- Data source data link 2 PCM measurements measurement list name: ML 1

Instance Document: measurement-list-rpm-group-linking-test-case-001.xml

Relevant User Stories: [US-10](#)

Deficiencies: [D-21](#)

TC-7. PCM Format Metadata Description

Details: Define the metadata for a PCM format.

- Data source data link name: PCM_STREAM
- Data source data link PCM format attributes input data PCM code: NRZ-L
- Data source data link PCM format attributes input data bit rate: 2000000
- Data source data link PCM format attributes input data encrypted: Unencrypted
- Data source data link PCM format attributes input data polarity: Normal
- Data source data link PCM format attributes input data auto polarity correction: Yes
- Data source data link PCM format attributes input data direction: Normal
- Data source data link PCM format attributes input data randomized: No
- Data source data link PCM format attributes input data randomized length: Not Applicable
- Data source data link PCM format attributes format type format: Class 1
- Data source data link PCM format attributes format common word length: 16

- Data source data link PCM format attributes format word transfer order: MSB First
- Data source data link PCM format attributes format Parity: None
- Data source data link PCM format attributes format minor frame number of minor frames: 2
- Data source data link PCM format attributes format minor frame words per minor frame: 5
- Data source data link PCM format attributes format sync type: Fixed Pattern
- Data source data link PCM format attributes format sync pattern: 11111010111100110010000001110101
- Data source data link PCM format attributes sync criteria in sync criteria: Not Specified
- Data source data link PCM format attributes sync criteria in sync number of FSP bits: 0
- Data source data link PCM format attributes sync criteria out sync number of FSP bits: 0
- Data source data link PCM format attributes subframe synchronization ID counter name: SFID
- Data source data link PCM format attributes subframe synchronization ID counter sync type: ID Counter
- Data source data link PCM format attributes subframe synchronization ID counter location: 1
- Data source data link PCM format attributes subframe synchronization ID counter starting bit location: 16
- Data source data link PCM format attributes subframe synchronization ID counter length: 1
- Data source data link PCM format attributes subframe synchronization ID counter transfer order: Default
- Data source data link PCM format attributes subframe synchronization ID counter initial value: 0
- Data source data link PCM format attributes subframe synchronization ID counter initial minor frame number: 1
- Data source data link PCM format attributes subframe synchronization ID counter end value: 1
- Data source data link PCM format attributes subframe synchronization ID counter end minor frame number: 1
- Data source data link PCM format attributes subframe synchronization ID counter count direction: Increasing

Instance Document: pcm-format-test-case-001.xml

Relevant User Stories: [US-11](#)

Deficiencies: [D-6](#), [D-7](#), [D-8](#), [D-9](#), [D-10](#), [D-11](#)

TC-8. PCM Major Frame Structure Metadata Description
Details: Define the metadata for a PCM major frame.

- Data source data link name: PCM_STREAM
- Data source data link PCM format attributes input data PCM code: NRZ-L
- Data source data link PCM format attributes input data bit rate: 1500000
- Data source data link PCM format attributes format common word length: 16
- Data source data link PCM format attributes format word transfer order: MSB First
- Data source data link PCM format attributes format Parity: None
- Data source data link PCM format attributes format minor frame number of minor frames: 2
- Data source data link PCM format attributes format minor frame words per minor frame: 13
- Data source data link PCM format attributes format minor frame bits per minor frame: 0
- Data source data link PCM format attributes subframe synchronization as in [TC-6](#)

Instance Document: pcm-major-frame-structure-test-case-001.xml

Relevant User Stories: [US-16](#)

Deficiencies: None.

TC-9. PCM Major Frame Contents (Word and Frame) Metadata Description

Details: Define the metadata for the contents of a PCM major frame using the word and frame location pattern.

- Data source type: RF
- Data source data link name: PCM_STREAM
- Data source data link PCM format attributes PCM measurements measurement list name: ML1
- Data source data link PCM format attributes PCM measurements measurement list measurement name: M1
- Data source data link PCM format attributes PCM measurements measurement list measurement parity: Default
- Data source data link PCM format attributes PCM measurements measurement list measurement parity transfer order: Default
- Data source data link PCM format attributes PCM measurements measurement list measurement transfer order: Default
- Data source data link PCM format attributes PCM measurements measurement list measurement location type: Word and Frame
- Data source data link PCM format attributes PCM measurements measurement list measurement word and frame measurement location measurement fragments fragment position: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement word and frame measurement location measurement fragments start word: 1

- Data source data link PCM format attributes PCM measurements measurement list measurement word and frame measurement location measurement fragments word interval: 0
- Data source data link PCM format attributes PCM measurements measurement list measurement word and frame measurement location measurement fragments start frame: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement word and frame measurement location measurement fragments frame interval: 0
- Data source data link PCM format attributes PCM measurements measurement list measurement word and frame measurement location measurement fragments bit mask: Full Word

Instance Document: pcm-major-frame-contents-test-case-001.xml

Relevant User Stories: [US-17](#), [US-18](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-12](#)

TC-10. PCM Location Type Metadata Description

Details: Metadata description for PCM word and frame location using TIREPRESSURE1 ENGINETEMPERATURE measurements in the PCM_STREAM data link and ML1 measurement list.

- Data source type: RF
- Data source data link name: PCM_STREAM
- Data source data link PCM format attributes PCM measurements measurement list name: ML1
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 name: TIREPRESSURE1
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 parity: Default
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 measurement transfer order: Default
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 location type: Word and Frame
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 word and frame measurement location measurement fragments 1 start word: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 word and frame measurement location measurement fragments 1 start frame: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 word and frame measurement location measurement fragments 2 start word: 1

- Data source data link PCM format attributes PCM measurements measurement list measurement 1 word and frame measurement location measurement fragments 2 start frame: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement 1 word and frame measurement location measurement fragments 2 bit mask: Full Word
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 name: ENGINETEMPERATURE
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 parity: Default
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 measurement transfer order: Default
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 location type: Word and Frame
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 word and frame measurement location measurement fragments 1 start word: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 word and frame measurement location measurement fragments 1 start frame: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 word and frame measurement location measurement fragments 2 start word: 1
- Data source data link PCM format attributes PCM measurements measurement list measurement 2 word and frame measurement location measurement fragments 2 start frame: 1

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-19](#), [US-20](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: None

TC-11. One measurement in exactly one word position in every minor frame location type metadata description.

Details: Metadata description for WFA measurement in the AIRCRAFT data link. Details of the metadata are shown graphically in [Figure 2](#).

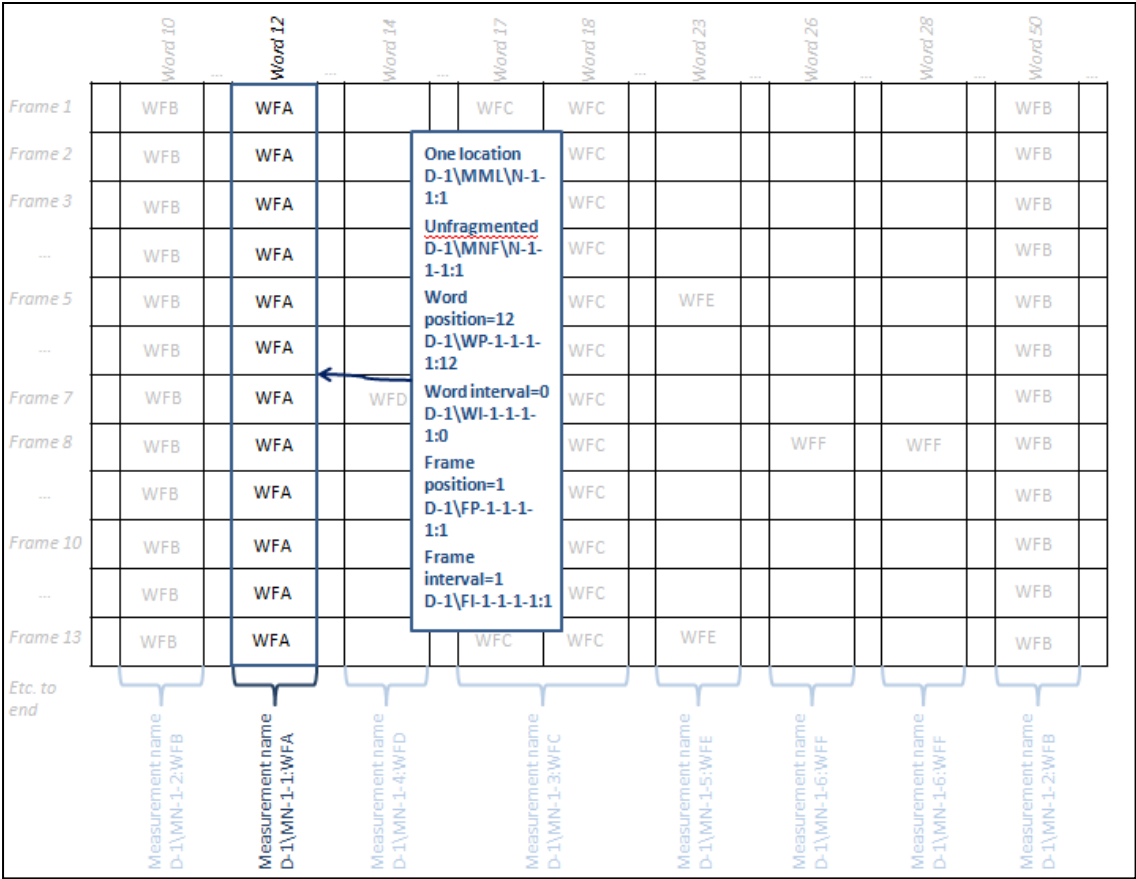


Figure 2. Minor Frame Measurement

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-23](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-13](#)

- TC-12. Minor frame supercommutated location type metadata description
Details: Metadata description for WFB measurement in the AIRCRAFT data link.
Details of the metadata are shown graphically in [Figure 3](#).

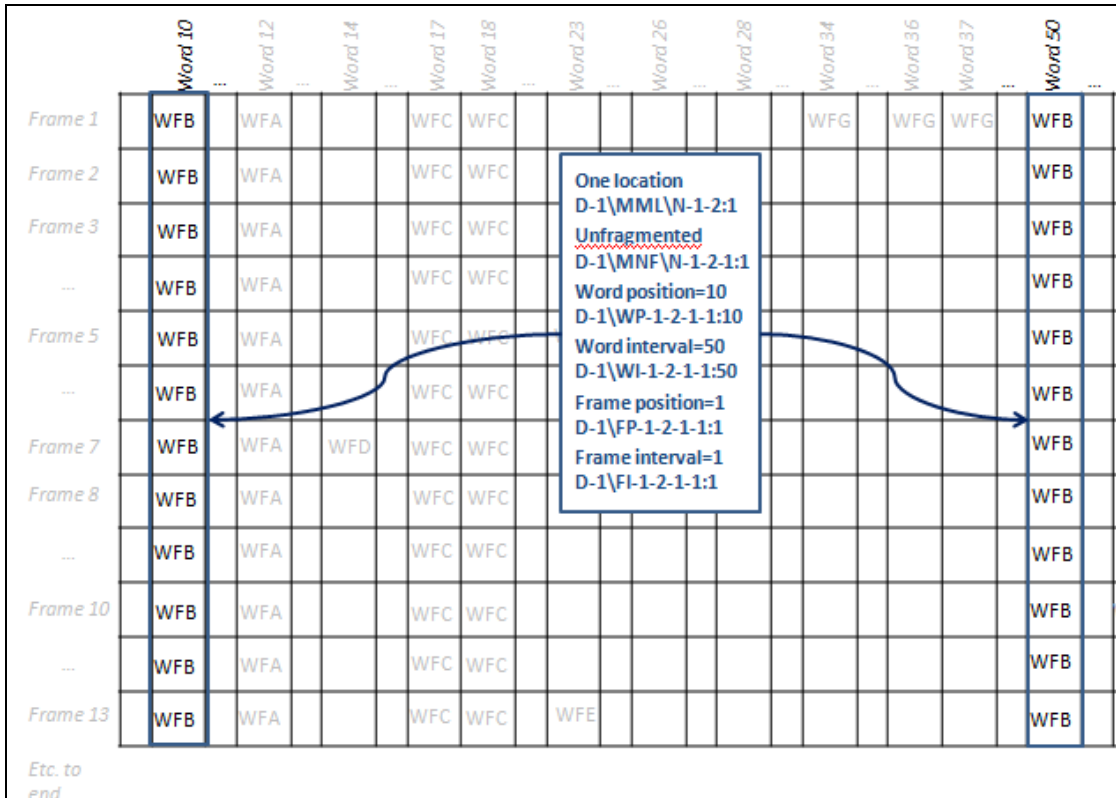


Figure 3. Minor Frame Supercommutated Measurement

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-24](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-13](#)

- TC-13. Minor frame fragmented location type metadata description
Details: Metadata description for WFC measurement in the AIRCRAFT data link.
 Details of the metadata are shown graphically in [Figure 4](#).

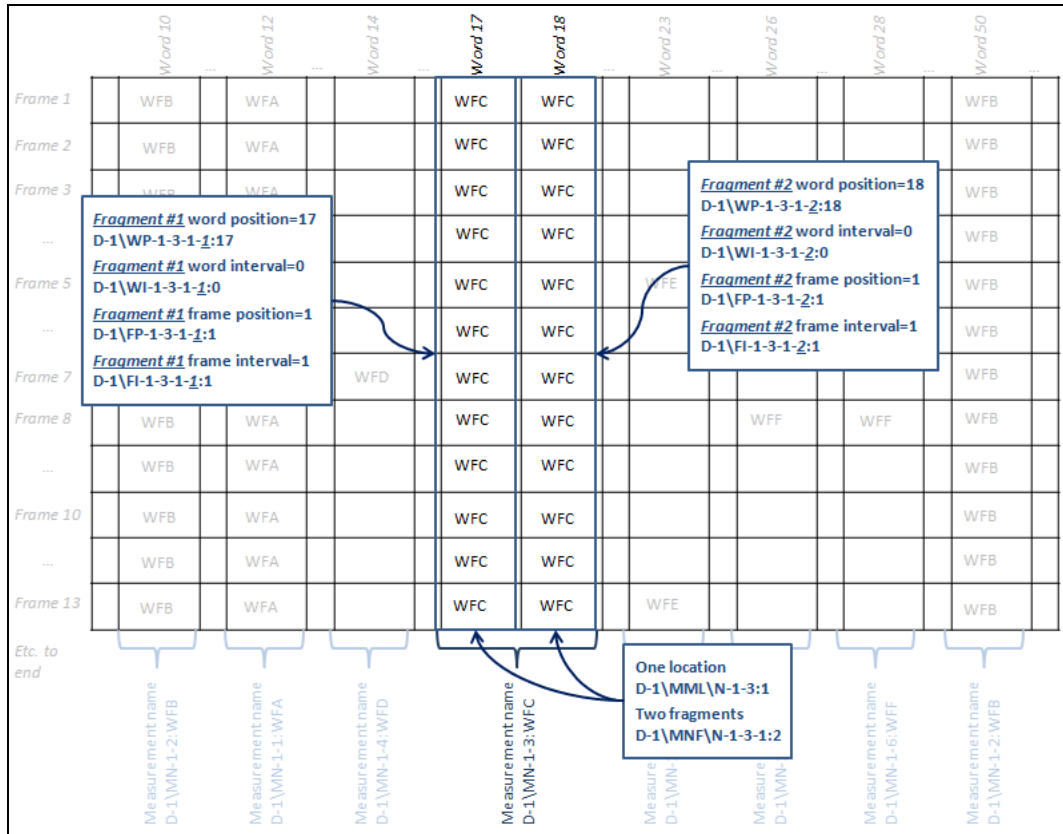


Figure 4. Minor Frame Fragmented Measurement

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-26](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-13](#)

TC-14. Subcommutated measurement location metadata description

Details: Metadata description for WFD measurement in the AIRCRAFT data link.

Details of the metadata are shown graphically in [Figure 5](#).

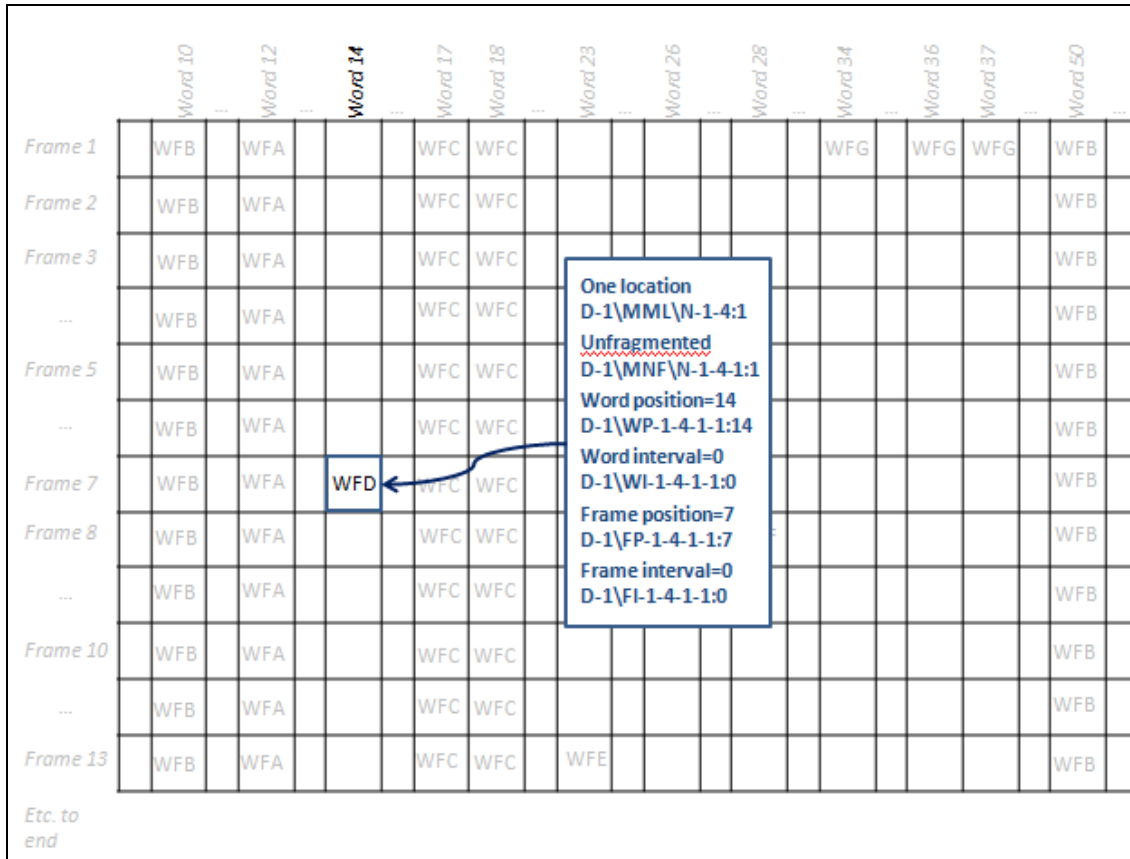


Figure 5. Subframe Management

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-27](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-13](#)

- TC-15. Supersubcommutated and fragmented subcommutated location metadata
Details: Metadata description for WFE measurement (supersubcommutated) in the AIRCRAFT data link. Details of the metadata are shown graphically in [Figure 6](#).

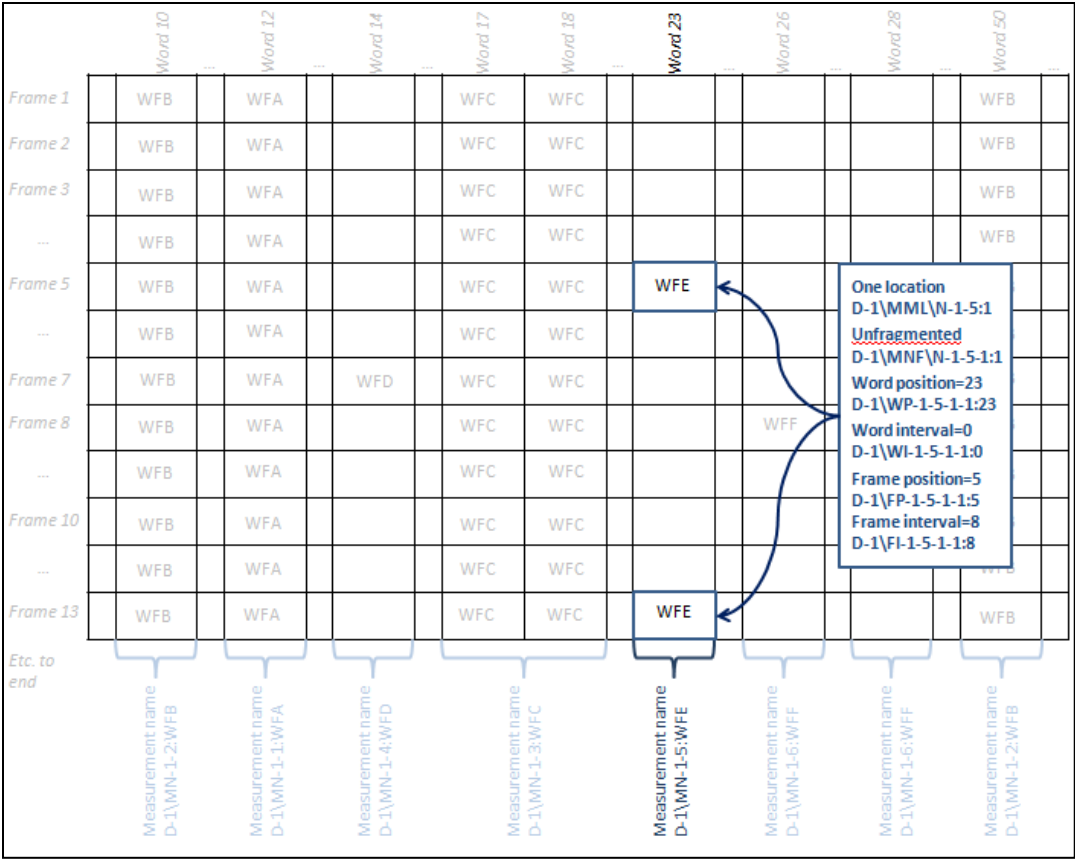


Figure 6. Subframe Supercommutated Measurement

Metadata description for WFF measurement (fragmented subcommutated) in the AIRCRAFT data link. Details of the metadata are shown graphically in the following figure from the TMATS handbook (Figure 5-6).

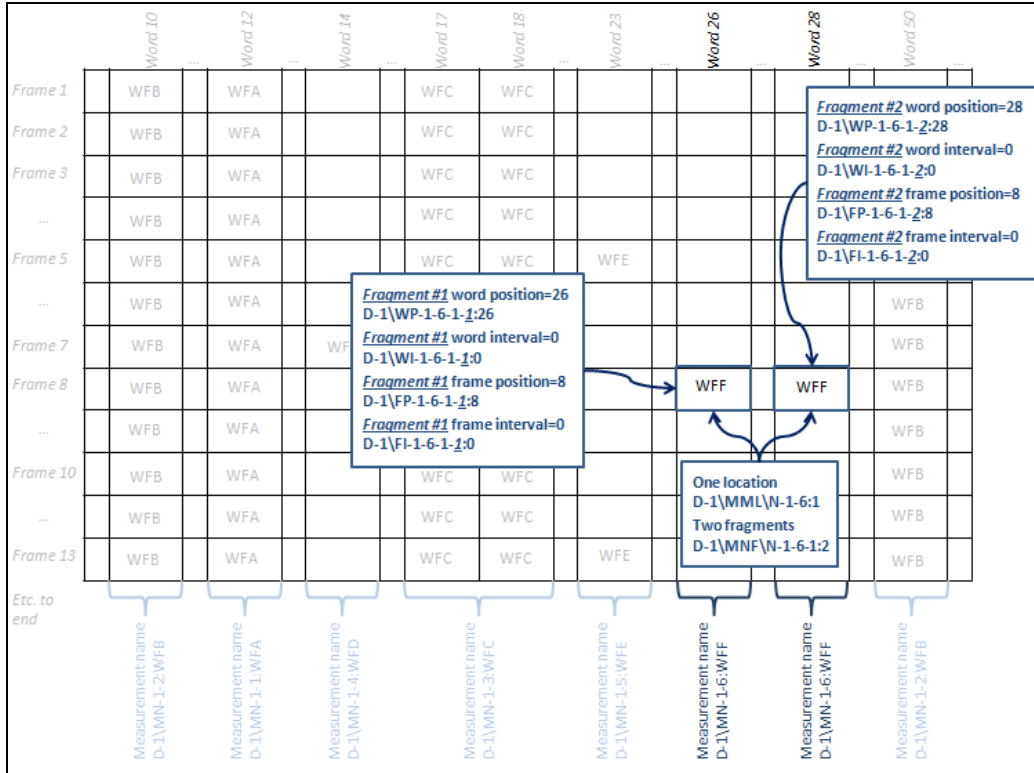


Figure 7. Subframe Fragmented Measurement

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-28](#), [US-29](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-13](#)

TC-16. Fragmented supersubcommutated location metadata description

Details: Metadata description for WFG measurement in the AIRCRAFT data link.

Details of the metadata are shown graphically in [Figure 8](#) for location 1 and [Figure 9](#) for location 2.

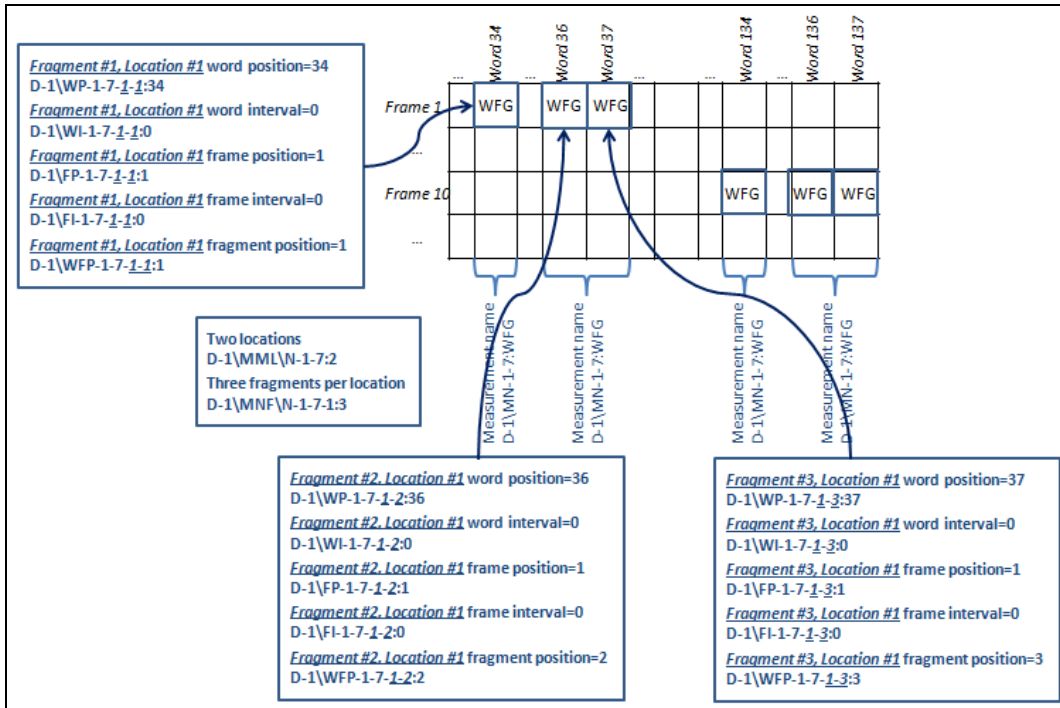


Figure 8. Subframe Fragmented Measurement in Multiple Locations (Location 1)

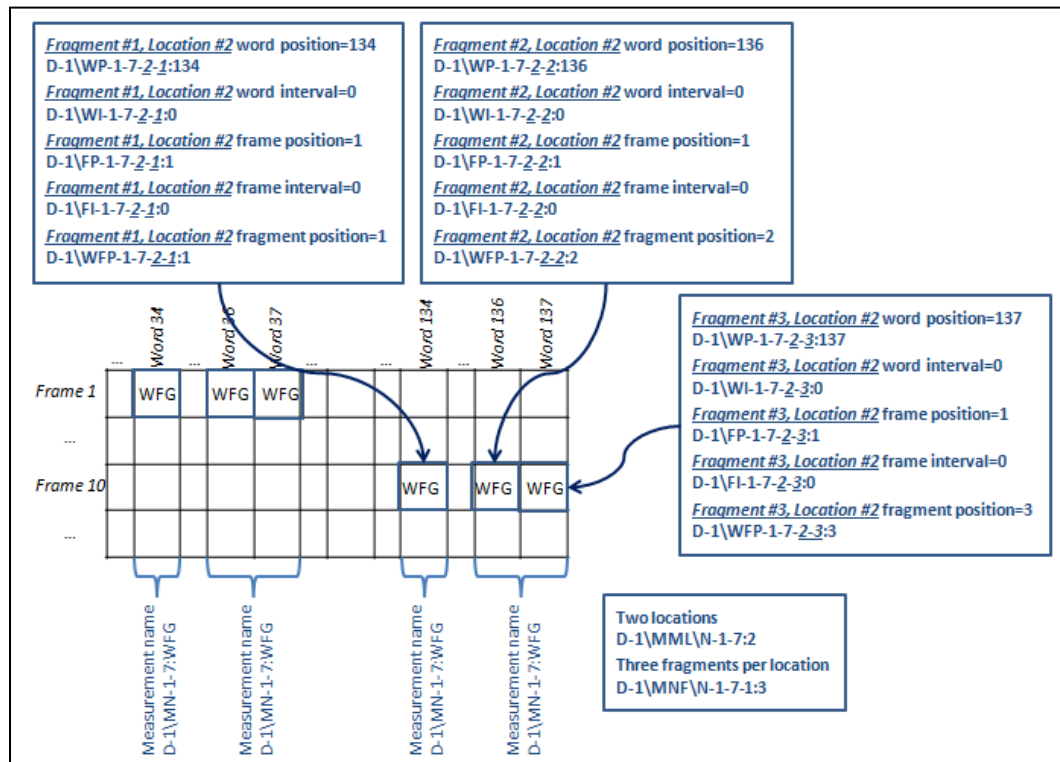


Figure 9. Subframe Fragmented Measurement in Multiple Locations (Location 2)

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-30](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-13](#)

- TC-17. Fragmented supercommutated measurement location metadata description
Details: Metadata description for WFH measurement in the AIRCRAFT data link.
 Details of the metadata are shown graphically in [Figure 10](#).

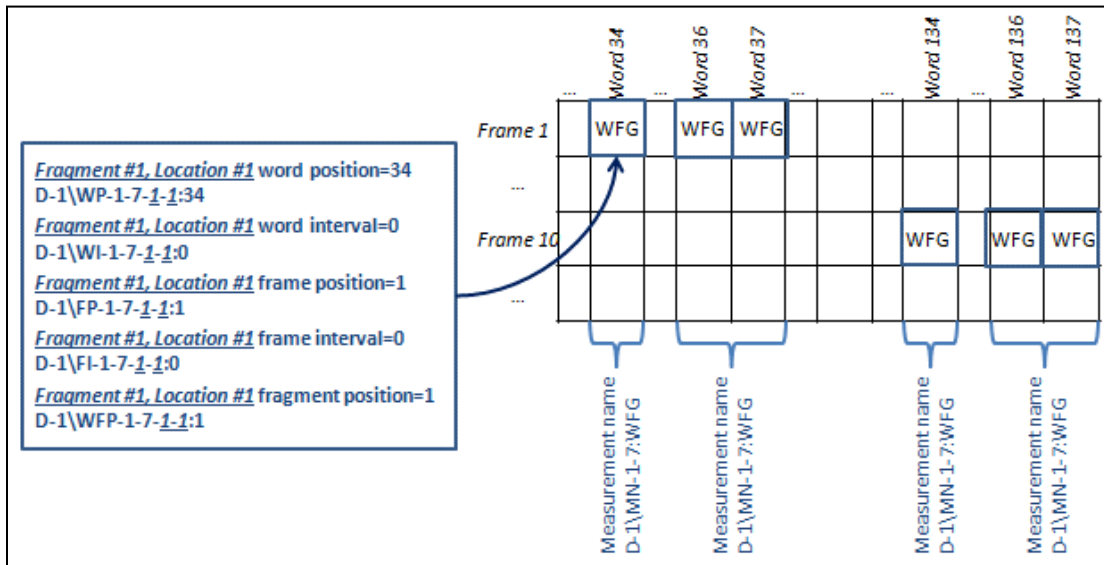


Figure 10. Subframe Fragmented Measurement in Multiple Locations
 (Location 1, Fragment 1)

Instance Document: pcm-location-type-test-case-001.xml

Relevant User Stories: [US-31](#), [US-38](#), [US-39](#), [US-40](#), [US-41](#), [US-42](#), [US-43](#)

Deficiencies: [D-13](#)

- TC-18. Data conversion metadata description
Details: Metadata description for TIREPRESSURE1 and TIREPRESSURE2 measurement conversions.

- Data source data link data conversion attributes measurement 1 name: TIREPRESSURE1
- Data source data link data conversion attributes measurement 1 data conversion type: Coefficients
- Data source data link data conversion attributes measurement 2 name: TIREPRESSURE2
- Data source data link data conversion attributes measurement 2 data conversion type: Coefficients

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-46](#), [US-47](#)

Deficiencies: [D-16](#)

TC-19. Pair set data conversion method metadata description

Details: Metadata description for TIREPRESSURE3 measurement.

- Data source data link data conversion attributes measurement 3 name: TIREPRESSURE3
- Data source data link data conversion attributes measurement 3 data conversion type: Pair Sets

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-48](#)

Deficiencies: [D-17](#)

TC-20. Coefficients data conversion method metadata description

Details: Metadata description for TIREPRESSURE4 measurement.

- Data source data link data conversion attributes measurement 4 name: TIREPRESSURE4
- Data source data link data conversion attributes measurement 4 data conversion type: Coefficients

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-49](#)

Deficiencies: None.

TC-21. Derived conversion method metadata description

Details: Metadata description for TIREPRESSURE5 measurement.

- Data source data link data conversion attributes measurement 5 name: TIREPRESSURE5
- Data source data link data conversion attributes measurement 5 data conversion type: Derived

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-51](#)

Deficiencies: [D-18](#)

TC-22. Discrete conversion method metadata description

Details: Metadata description for TIREPRESSURE6 measurement.

- Data source data link data conversion attributes measurement 6 name: TIREPRESSURE6

- Data source data link data conversion attributes measurement 6 data conversion type: Discrete

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-52](#)

Deficiencies: None

TC-23. PCM time conversion method metadata description

Details: Metadata description for TIREPRESSURE7 measurement.

- Data source data link data conversion attributes measurement 7 name: TIREPRESSURE7
- Data source data link data conversion attributes measurement 7 data conversion type: PCM Time

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-53](#)

Deficiencies: None

TC-24. 1553 time conversion method metadata description

Details: Metadata description for TIREPRESSURE8 measurement.

- Data source data link data conversion attributes measurement 8 name: TIREPRESSURE8
- Data source data link data conversion attributes measurement 8 data conversion type: 1553 Time

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-54](#)

Deficiencies: None

TC-25. Digital voice conversion method metadata description

Details: Metadata description for TIREPRESSURE9 measurement.

- Data source data link data conversion attributes measurement 9 name: TIREPRESSURE9
- Data source data link data conversion attributes measurement 9 data conversion type: Voice

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-55](#)

Deficiencies: None

TC-26. Digital video conversion method metadata description

Details: Metadata description for TIREPRESSURE10 measurement.

- Data source data link data conversion attributes measurement 10 name: TIREPRESSURE10
- Data source data link data conversion attributes measurement 10 data conversion type: Video

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-56](#)

Deficiencies: [D-19](#)

TC-27. Special processing conversion method metadata description
Details: Metadata description for TIREPRESSURE11 measurement.

- Data source data link data conversion attributes measurement 11 name: TIREPRESSURE11
- Data source data link data conversion attributes measurement 11 data conversion type: Special Processing

Instance Document: data-conversion-test-case-001.xml

Relevant User Stories: [US-57](#)

Deficiencies: [D-20](#)

TC-28. Transmission metadata description
Details: Metadata description for transmission attributes.

- Data source type: RF
- Data source transmission attributes source RF attributes transmitter ID: ST405S
- Data source transmission attributes source RF attributes frequency: 2251.5
- Data source transmission attributes source RF attributes RF bandwidth: NRZ-L
- Data source transmission attributes source RF attributes data bandwidth: 750
- Data source transmission attributes source RF attributes modulation type: FM
- Data source transmission attributes source RF attributes total carrier modulation: 750
- Data source transmission attributes source RF attributes power: 2.5
- Data source transmission attributes source RF attributes subcarrier number: 1
- Data source transmission attributes source RF attributes modulator non linearity: 2.0
- Data source transmission attributes source RF attributes premodulation filter bandwidth: 1400
- Data source transmission attributes source RF attributes premodulation filter slope: 6.0
- Data source transmission attributes source RF attributes premodulation filter type: Constant Amplitude
- Data source transmission attributes source RF attributes transmit antenna type: Blade

- Data source transmission attributes source RF attributes transmit antenna polarization: Linear
- Data source transmission attributes source RF attributes transmit antenna location: BELLY
- Data source transmission attributes source RF attributes antenna patterns document: Dwg A2345-1

Instance Document: transmission-test-case-001.xml

Relevant User Stories: [US-58](#), [US-59](#)

Deficiencies: None

4.2 IHAL

TC-29. Thermocouple Signal Conditioning

Details: Configure a simple system consisting of a thermocouple connected to one channel of an analog signal conditioning card, plugged into one DAU:

- DAU: Curtiss-Wright Corporation's KAM/CHS/13U (<http://www.cwc-ae.com/product/kamchs13u>)
- Card Attributes: KAD/ADC/112/10V (<http://www.cwc-ae.com/product/kadadc112>)
 - Number of Channels: 24
 - Connected to Slot 5 of DAU
 - Minimum Input Voltage: -10V to 10V
 - Channel 0: -10V
 - Channel 1: -9V
 - Channel 2-23: -10V
 - Maximum Input Voltage: -10V to 10V
 - Channel 0: 10V
 - Channel 1: 8V
 - Channel 2-23: 10V
 - Cutoff Frequency: One of 0.25; 0.5; 1; 2; 4; 8; 16
 - Channel 0: 0.25
 - Channel 1: 1
 - Channel 2-22: 0.25
 - Channel 23: 0.5
- Thermocouple: Omega 88302K (http://www.omega.com/pptst/88000_thinfoil.html)
 - Connected to Channel 1 of Card.
 - Max Operating Temperature: 1172 K
 - Calibration Type: K
 - Lead Length: 12 in.
 - Lead Insulation Type: PFA
 - Sheath Type: 304 SS
 - Sheath Diameter: 1/16 in.

Instance Document: ThermoCoupleSignalConditioning.xml

Relevant User Stories: [US-79](#)

Deficiencies: [D-22](#), [D-23](#)

TC-30. ARINC-429 Bus Monitoring

Details: Configure a simple system consisting of a DAU and an ARINC-429 Bus Monitor Card.

- DAU:
 - Curtiss-Wright Corporation's KAM/CHS/13U (<http://www.cwc-ae.com/product/kamchs13u>)
- ARINC-429 Bus Monitor Card:
 - Curtiss-Wright Corporation's KAD/ABM/101 (<http://www.cwc-ae.com/product/kadabm101>)
- Bus Monitor Card Attributes: KAD/ABM/101
 - Function: Snarfer Filter
 - Configurable Attribute: FIFO Level-25
 - Valid Values:
 - Traffic, MessageCount, IrigTime, Error ← Default Value
 - Traffic, IrigTime, Error
 - Traffic, IrigTime
 - Traffic, Error
 - Error
 - None
 - Current Value: Traffic, MessageCount, IrigTime, Error
- Number of Channels: 8
 - Configurable Attribute: Bit Rate
 - Valid Values: 100000, 50000, 12500
 - Default Value: 12500
 - Current Value: 100000 on Channel 1
 - Configurable Attribute: Check For Parity
 - Valid Values: true, false
 - Default Value: false
 - Current Value: false on Channel 1
- Data Stream: ARINC429
 - Message: MyARINC-429Message
 - Label: 125
 - Data Format: BNR
 - SSM: 11
 - SDI: "all"
 - Measurement: 0x00000000 "ARINC-429-MessageData"
- Connections
 - ARINC 429 Bus Monitor Card connected to DAU slot 6
 - ARINC 429 Bus Monitor Card connected to data stream
 - Sampling measurement: 0x00000000 "ARINC-429-MessageData"

Instance Document: BusMonitorUseCase.xml

Relevant User Stories: [US-86](#)

Deficiencies: [D-24](#), [D-25](#), [D-26](#)

TC-31. PCM Encoder Configuration

Details: Configure a simple system consisting of a DAU and a PCM encoder card outputting one PCM stream with one measurement.

- DAU:
 - Curtiss-Wright Corporation's KAM/CHS/13U (<http://www.cwc-ae.com/product/kamchs13u>)
- PCM Card:
 - Curtiss-Wright Corporation's KAD/BCU/101/C (<http://www.cwc-ae.com/product/kadbcu101>)
- PCM Card Attributes: KAD/BCU/101/C
 - Card-Level Attributes:
 - DAU ID
 - Valid Values: integers between 0 and 63, inclusive
 - Default Value = 0
 - Current Value = 5
 - Output Channels: 4
 - Configurable Attributes:
 - Stream ID
 - Valid Values: strings that match "[0-9a-fA-F]{1,8}"
 - Default Value = "FFFFFFFF"
 - Current = "CAFEDEAD"
 - PCM Code
 - Valid Values:
 - NRZ-L
 - NRZ-M
 - NRZ-S
 - BIO-L
 - BIO-M
 - BIO-S
 - RNRZ-L
 - Default Value = NRZ-L
 - Current Value = NRZ-L
 - Bit Rate
 - Valid Values: 500 – 200000000 in steps of 0.5
 - Default Value = 6400000
 - Current Value = 6400000
 - Number of Minor Frames
 - Current Value = 5

- Words Per Minor Frame
 - Current Value = 64
 - Bits Per Minor Frame
 - Current Value =1024
 - Sync Pattern
 - Current Value
=11111110011010110010100001000000
 - Output format on channel 1:
 - Measurement “Analog_0” at word 4, frame 1
- Connections:
 - PCM Encoder Card connected to DAU slot 2

Instance Document: PCMEncoderUseCase.xml

Relevant User Stories: [US-90](#)

Deficiencies: [D-27](#), [D-28](#)

4.3 DDML Test Cases

TC-32. Simple DDML Definition

Details: Define a DDML instance document with minimal data.

- Define a Project
 - Name: Schema Validation Task
 - ID: PROJ1
- Define a Model
 - Name: Schema Validation Model
 - ID: MOD1
 - Minx:0, Miny:0, Maxx:1000, Maxy:1000
 - xDirection: RIGHT, yDirection: UP
 - BackgroundColor: 65280 (Green)
 - Display Object
 - Name: Schema Validation Display Object
 - Point1: 0, 0
 - Point2: 500, 1000
 - Point3: 1000, 0
- Define Data Variable in Pool
 - Name: Schema Validation Variable
 - ID: V1
 - Data Source Reference: S1
- Define Data Source in Pool
 - Name: Schema Validation Data Source
 - ID:S1

Instance Document: TC-1_SimpleDDMLDefinition.ddml

Relevant User Stories: [US-102](#), [US-133](#), [US-134](#)

Deficiencies: N/A

TC-33. Define Data Source pool
Details: Define an extensive data source pool

- Data Source 1:
 - Name: S1SRP
 - ID: S1SRP
 - Parameters (Name, Value):
 - Type, FIXED-REF
 - Save, 0
 - Stream, 0
 - Symbol, SQUARE
 - Track Color, 65280
 - Scale, 0.5
 - Track Type, TSPI
 - Site, 3
 - Hide, True
- Data Source 2:
 - Name: SHT1A
 - ID: SHT1A
 - Parameters (Name, Value):
 - Type, RADAR
 - Save, 1
 - Stream, 0
 - Symbol, AIRPLANE
 - Track Color, 65280
 - Scale, 0.5
 - Track Type, TSPI
 - Site, 3
- Data Source 3:
 - Name: EAU01
 - ID: EAU01
 - Parameters (Name, Value):
 - Type, EATS
 - Save, 1
 - Stream, 0
 - Symbol, AIRPLANE
 - Track Color, 65280
 - Scale, 0.5
 - Track Type, TSPI
 - Site, 3
- Data Source 4:

- Name: S1
- ID: S1
- Parameters (Name, Value):
 - Type, SELECT
 - Save, 1
 - Stream, 0
 - Symbol, AIRPLANE
 - Track Color, 65280
 - Scale, 0.5
 - Track Type, TSPI
 - Site, 3
- Data Source 5:
 - Name: IIP01
 - ID: IIP01
 - Parameters (Name, Value):
 - Type, IIP01
 - Save, 1
 - Stream, 0
 - Symbol, TRIANGLE
 - Track Color, 65280
 - Scale, 0.5
 - Track Type, TSPI
 - Site, 3
- Data Source 6:
 - Name: TM
 - ID: TM
 - Parameters (Name, Value):
 - Type, TPS
 - Save, 1
 - Stream, 0
 - Symbol, AIRPLANE
 - Track Color, 16777215
 - Scale, 0.5
 - Track Type, TSPI
 - Site, 3

Instance Document: TC-2_DefineDataSourcePool.ddml

Relevant User Stories: [US-103](#), [US-133](#), [US-134](#), [US-195](#), [US-196](#), [US-197](#), [US-198](#), [US-199](#)

Deficiencies: [D-29](#)

- TC-34. Define Data Variable Pool
Details: Define a data variable pool.

- Data Variables (ID-Name):
 - Var0-IRIG_DAYS, Var1-IRIG_HOURS, Var2-IRIG_MIN, Var3-IRIG_SEC, Var4-IRIG_MSEC, Var5-IRIG_PTN, Var6-IRIG_COURSE-M, Var7-VEL-KTS, Var8-ALT-KFT, Var9-SR-NMI, Var10-ANGLE-ELV, Var11-ANGLES-OFF, Var12-BEARING-M, Var13-TRK-ANGLE, Var14-CVEL-KTS, etc.

Instance Document: TC-3_DefineDataVariablePool.ddml

Relevant User Stories: [US-95](#), [US-188](#), [US-189](#), [US-190](#), [US-191](#), [US-192](#), [US-193](#), [US-194](#)

Deficiencies: N/A

TC-35. Define Model

Details: Define a model with more information.

- Model Name: SELMAP
- Minx: 0
- Maxx: 1300000
- Miny: 0
- Maxy: 1000000
- X Direction: RIGHT
- Y Direction: DOWN
- BackgroundColor: 255 (red)
- Display Object
 - Name: Schema Validation Display Object
 - Point1: 0, 0
 - Point2: 500, 1000
 - Point3: 1000, 0
- Parameter:
 - Name: Screens
 - Value: GRIDS
- ShowInProject: false

Instance Document: TC-4_DefineModel.ddml

Relevant User Stories: [US-112](#), [US-113](#), [US-114](#)

Deficiencies: [D-29](#)

TC-36. Define Textual Display Object

Details: Define a textual display object within a model.

- Display Object Name: SELMAPTOD
- ID: SELMAPTOD
- Point1: 1000000, 0
- Point2: 1000000, 40000
- Point3: 1300000, 40000
- Point4: 1300000, 0

- Orientation: HORIZONTAL
- Value Position: CENTER
- Value Format: %3d:%2d:%2d:%2d.%3d
- Custom Parameters (Name, Value):
 - RVsubType, TOD
 - Framed, False
- Dynamics:
 - Type: text
 - Variable Uses (ID, Name, Pool Ref, Color)
 - Vu0, IRIG_DAYS, var0, 16777215
 - Vu1, IRIG_HOURS, var1, 16777215
 - Vu2, IRIG_MIN, var2, 16777215
 - Vu3, IRIG_SEC, var3, 16777215
 - Vu4, IRIG_MSEC, var4, 16777215
 - Rules:
 - If < 0, Value = 0

Instance Document: TC-5_DefineTextualDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-94](#), [US-97](#), [US-98](#), [US-99](#), [US-133](#), [US-134](#), [US-165](#), [US-166](#), [US-167](#), [US-168](#), [US-169](#), [US-170](#), [US-171](#), [US-172](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: [D-29](#)

TC-37. Define Map Display Object

Details: Define a map display object within a model.

- Display Object Name: SELECT-MAP
- ID: SELECT-MAP
- Point1: 0, 0
- Point2: 0, 1000000
- Point3: 1000000, 1000000
- Point4: 1000000, 0
- Custom Parameters (Name-Value):
 - Trace-S1, Scale-OFF, NTDS-ON, Topography-NAWC, Legend-ON, Size-NMI, Cursor-ON, Updates-0.0
- Min Latitude: 30.0
- Max Latitude: 37.0
- Min Longitude: -125.1
- Max Longitude: -118.1
- Background Images (ID, Filename):
 - SELECT-MAP_world, maps/world.map
 - SELECT-MAP_socal, Maps/R-2508/SoCal-2508.map

Instance Document: TC-6_DefineMapDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-116](#), [US-117](#), [US-118](#), [US-133](#), [US-134](#), [US-183](#)

Deficiencies: [D-29](#), [D-30](#)

TC-38. Define Custom Display Object

Details: Define a generic display object within a model.

- Display Object Name: background_ALT
- ID: background_ALT
- Custom Parameter (Name-Value):
 - gridsSubTypes-background, Points-40.0, Graphics-LINKED, Marker-POINT, Color-RED, Linetype-SOLID, Label-, Font-0, Orient-RIGHT, Justify-LEFT, Offsets-0,0, Smoothness-0.0, Center-(0.0, 0.0), Radius-0.0, xAxis-0.0, yAxis-0.0, Azimuth-0.0, Arcbegin-0.0, Arclength-0.0, Name-ALT
- SVG
 - ID: SVG1
 - ImageRendering: optimizeSpeed
 - ColorRendering: optimizeSpeed
 - OnMouseDown: event
 - Stroke-Opacity: 80
 - Height: 1000
 - FontSize: 14
 - FontStyle: Normal
 - EnableBackground: false
- SVG Description
 - ID: D1
 - Space: default
 - Language: en-us
 - Base: http://www.altova.com
 - Class: Custom
 - Style: Normal

Instance Document: TC-7_DefineCustomDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-98](#), [US-99](#), [US-100](#), [US-101](#), [US-133](#), [US-134](#), [US-143](#), [US-144](#)

Deficiencies: [D-29](#)

TC-39. Define Bar Chart Display Object

Details: Define a bar chart display object with axes within a model.

- Display Object Name: BAGC1
- ID: BAGC1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Bar Chart

- Title Font: Arial
- Title Font Size: 24
- Title Color: 65280
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules
 - If < 0, Value = 0
- X Axis:
 - Color: 0
 - Type: TIME
- Y Axis:
 - Type: VALUE
 - Min: 0
 - Max: 5
 - Label Foreground Color: 0
 - Axis Grid 1:
 - Grid Interval: 2.5
 - Grid Color: 16711935
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 2:
 - Grid Color: 58302
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 3:
 - Tick Label Color: 0
 - Tick Label Format: %4.2f
- Scroll Direction: DOWN

Instance Document: TC-8_DefineBarChartDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-106](#), [US-119](#), [US-120](#), [US-121](#), [US-123](#), [US-125](#), [US-126](#), [US-128](#), [US-129](#), [US-131](#), [US-132](#), [US-133](#), [US-134](#), [US-135](#), [US-136](#), [US-137](#), [US-145](#), [US-146](#), [US-147](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

TC-40. Define Frequency Plot Display Object

Details: Define a frequency plot display object with axes within a model.

- Display Object Name: FREQ1
- ID: FREQ1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Frequency Plot
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules
 - If < 0, Value = 0
- Frequency Axis:
 - Color: 0
 - Type: TIME
 - Unit: Radians
- Magnitude Axis:
 - Type: VALUE
 - Min: 0
 - Max: 100
 - Unit: Volts
 - Label Foreground Color: 0
 - Axis Grid 1:
 - Grid Interval: 2.5
 - Grid Color: 16711935
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 2:
 - Grid Color: 58302
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 3:
 - Tick Label Color: 0
 - Tick Label Format: %4.2f

Instance Document: TC-9_DefineFrequencyPlotDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-119](#), [US-120](#), [US-121](#), [US-123](#), [US-124](#), [US-125](#), [US-126](#), [US-128](#), [US-129](#), [US-131](#), [US-132](#), [US-133](#), [US-134](#), [US-148](#), [US-149](#), [US-150](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

TC-41. Define Button Display Object

Details: Define a button display object within a model.

- Display Object Name: BTN1
- ID: BTN1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Button
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules
 - If < 0, Value = 0
- Label: Button

Instance Document: TC-10_DefineButtonDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-133](#), [US-134](#), [US-138](#), [US-139](#), [US-140](#), [US-141](#), [US-142](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: [D-34](#)

TC-42. Define Dial Display Object

Details: Define a dial display object within a model.

- Display Object Name: DIAL1
- ID: DIAL1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Dial
- Title Color: 16711680
- Dynamics:

- Type: built-in
- Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
- Rules
 - If < 0, Value = 0
- Axis Type: VALUE
- Minimum Angle: 30 degrees
- Maximum Angle: 120 degrees

Instance Document: TC-11_DefineDialDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-133](#), [US-134](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

TC-43. Define HUD Display Object
Details: Define HUD display object within a model.

- Display Object Name: HUD1
- ID: HUD1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Heads-Up Display
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules
 - If < 0, Value = 0
- Sub-Model Use
 - ID: MOD2
 - Point1: 0, 0
 - Point2: 0, 1000
 - Point3: 1000, 1000

Instance Document: TC-12_DefineHUDDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-96](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-115](#), [US-133](#), [US-134](#), [US-153](#), [US-154](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

TC-44. Define Pie Chart Display Object

Details: Define a pie chart display object within a model.

- Display Object Name: PIE1
- ID: PIE1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Pie Chart
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules
 - If >1 AND <100 continue
 - Else Value = 0
 - MathML
 - Divide by 100

Instance Document: TC-13_DefinePieChartDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-133](#), [US-134](#), [US-155](#), [US-156](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-181](#), [US-183](#), [US-186](#), [US-187](#)

Deficiencies: N/A

TC-45. Define Slider Display Object

Details: Define a slider object within a model inside a grid.

- Grid ID: GRID1
- Grid Name: GRID1
- Grid Rows: 2
- Grid Columns: 2
- Grid Point1: 0, 0
- Grid Point2: 10000, 0

- Grid Point3: 10000, 10000
- Display Object Name: SLID1
- Slider ID: SLID1
- Title: Slider
- Range: 0 to 100 mm
- Slider Grid Row: 1
- Slider Grid Column: 1
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules
 - If < 0, Value = 0
- Axis Type: VALUE
- Orientation: HORIZONTAL

Instance Document: TC-14_DefineSliderDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-108](#), [US-109](#), [US-133](#), [US-134](#), [US-159](#), [US-160](#), [US-161](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: [D-31](#), [D-32](#)

TC-46. Define Strip Chart Display Object
Details: Define a strip chart display object within a model.

- Display Object Name: STPC1
- ID: STPC1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Strip Chart
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules

- If < 0, Value = 0
- X Axis:
 - Color: 0
 - Type: TIME
- Y Axis:
 - Type: VALUE
 - Min: 0
 - Max: 5
 - Label Foreground Color: 0
 - Label Font Size: 10
 - Label Font: Arial
 - Axis Grid 1:
 - Grid Interval: 2.5
 - Grid Color: 16711935
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Show Ticks: false
 - Tick Label Font: Arial
 - Tick Label Size: 8
 - Axis Grid 2:
 - Grid Color: 58302
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 3:
 - Tick Label Color: 0
 - Tick Label Format: %4.2f
- Scroll Direction: DOWN
- Frame Scroll Duration: 10

Instance Document: TC-15_DefineStripChartDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-119](#), [US-120](#), [US-121](#), [US-122](#), [US-123](#), [US-125](#), [US-126](#), [US-128](#), [US-129](#), [US-131](#), [US-132](#), [US-133](#), [US-134](#), [US-162](#), [US-163](#), [US-164](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

TC-47. Define XY Chart Display Object

Details: Define *xy* chart display object within a model.

- Display Object Name: XY1
- ID: XY1
- Point1: 500000, 0
- Point2: 500000, 250000

- Point3: 750000, 250000
- Point4: 750000, 0
- Title: XY Chart
- Background Color: 0
- Data Area Color: 16777215
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name:vu0
 - Pool Ref: var19
 - Color: 65280
 - Variable Use
 - ID: vu1
 - Name: vu1
 - Pool Ref: var14
 - Color: 255
 - Rules
 - If < 0, Value = 0
- X Axis:
 - Color: 0
 - Type: TIME
- Y Axis:
 - Type: VALUE
 - Min: 0
 - Max: 1000
 - Label Foreground Color: 0
 - Axis Grid 1:
 - Grid Interval: 2.5
 - Grid Color: 16711935
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 2:
 - Grid Color: 58302
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 3:
 - Tick Label Color: 0
 - Tick Label Format: %4.2f
- Plot Type: LINES
- X Variable: TMBUF100
- Y Variable: TMBUF103

Instance Document: TC-16_DefineXYChartDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-94](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-107](#), [US-119](#), [US-120](#), [US-121](#), [US-123](#), [US-125](#), [US-126](#), [US-127](#), [US-128](#), [US-129](#), [US-130](#), [US-131](#), [US-132](#), [US-133](#), [US-134](#), [US-173](#), [US-174](#), [US-175](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

TC-48. Define Radial Chart Display Object
Details: Define radial chart display object within a model.

- Display Object Name: RAD1
- ID: RAD1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Radial Chart
- Background Color: 0
- Data Area Color: 16777215
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name:vu0
 - Pool Ref: var19
 - Color: 65280
 - Variable Use
 - ID: vu1
 - Name: vu1
 - Pool Ref: var14
 - Color: 255
 - Rules
 - If < 0, Value = 0
- Circular Axis:
 - Color: 0
 - Type: TIME
- Radial Axis:
 - Type: VALUE
 - Min: 0
 - Max: 1000
 - Label Foreground Color: 0
- Plot Type: LINES
- X Variable: TMBUF100

- Y Variable: TMBUF103

Instance Document: TC-17_DefineRadialChartDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-94](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-107](#), [US-119](#), [US-120](#), [US-121](#), [US-123](#), [US-132](#), [US-133](#), [US-134](#), [US-157](#), [US-158](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

TC-49. Define Frequency Response Plot Display Object

Details: Define a frequency response plot display object with axes within a model.

- Display Object Name: FREQR1
- ID: FREQR1
- Point1: 500000, 0
- Point2: 500000, 250000
- Point3: 750000, 250000
- Point4: 750000, 0
- Title: Frequency Response Plot
- Dynamics:
 - Type: built-in
 - Variable Use
 - ID: vu0
 - Name: TM1F001F
 - Pool Ref: var19
 - Color: 65280
 - Rules
 - If < 0, Value = 0
- Frequency Axis:
 - Color: 0
 - Type: TIME
 - Unit: Radians
- Magnitude Axis:
 - Type: VALUE
 - Min: 0
 - Max: 100
 - Unit: Volts
 - Label Foreground Color: 0
 - Axis Grid 1:
 - Grid Interval: 2.5
 - Grid Color: 16711935
 - Tick Color: 0
 - Tick Label Format: %4.2f
 - Axis Grid 2:

- Grid Color: 58302
- Tick Color: 0
- Tick Label Format: %4.2f
- Axis Grid 3:
 - Tick Label Color: 0
 - Tick Label Format: %4.2f
- Phase Axis:
 - Type: VALUE

Instance Document: TC-18_DefineFrequencyResponsePlotDisplayObject.ddml

Relevant User Stories: [US-93](#), [US-97](#), [US-98](#), [US-99](#), [US-104](#), [US-105](#), [US-119](#), [US-120](#), [US-121](#), [US-123](#), [US-124](#), [US-125](#), [US-126](#), [US-128](#), [US-129](#), [US-131](#), [US-132](#), [US-133](#), [US-134](#), [US-176](#), [US-177](#), [US-178](#), [US-179](#), [US-180](#), [US-183](#)

Deficiencies: N/A

5. Deficiencies

This section documents the current inconsistencies between the user stories, the test cases, and the instance documents. In some cases, these must be resolved with schema modifications. In others, they may be resolved by re-wording the user stories or test cases.

5.1 TMATS-XML

D-1. Number of data sources is missing.

Relevant Test Cases: [TC-1](#)

Resolution: The number of data sources is inferred from the number of child elements of type DataSource.

D-2. There is no data source ID, but there is a name; this is a string attribute.

Relevant Test Cases: [TC-1](#)

Resolution: needs to be reviewed by the committee.

D-3. There is no data source ID.

Relevant Test Cases: [TC-2](#), [TC-3](#), [TC-4](#)

Resolution: The data source ID is implied by the structure of the TMATS XML; it is found in the parent data source element.

D-4. The PAM data is not in the schema.

Relevant Test Cases:

Resolution: This is by design; remove all references to PAM from the user stories and test cases.

D-5. The DataLink does not have a name element or attribute.

Relevant Test Cases: [TC-5](#)

Resolution: Needs to be reviewed by the committee.

- D-6. Why is P:NumberOfMinorFrames needed? This is different than the pattern for other similar concepts.
Relevant Test Cases: [TC-6](#)
Resolution: This is necessary since the number of frames cannot be counted. No change required.
- D-7. Synchronization pattern length is missing.
Relevant Test Cases: [TC-6](#)
Resolution: This can be derived.
- D-8. The sync pattern criteria and out-of-sync pattern criteria have different names than are what is documented in Chapter 9.
Relevant Test Cases: [TC-6](#)
Resolution: The committee will need to look into this.
- D-9. The number of subframe ID counters is missing.
Relevant Test Cases: [TC-6](#)
Resolution: This can be inferred from the structure of the schema.
- D-10. There is no initial count subframe number.
Relevant Test Cases: [TC-6](#)
Resolution: Per the standard, it is always 1. The schema represents the logical structure.
- D-11. There is some confusion with the handbook regarding the minor frame number.
Relevant Test Cases: [TC-6](#)
Resolution: The committee will need to look into this.
- D-12. The number of location definitions is not found in the schema.
Relevant Test Cases: [TC-9](#)
Resolution: This can be inferred from the schema structure.
- D-13. The number of measurement locations and number of fragments is not in the XML.
Relevant Test Cases: [TC-11](#), [TC-12](#), [TC-13](#), [TC-14](#), [TC-16](#), [TC-17](#)
Resolution: These can be inferred from the structure of the schema.
- D-14. There is no data conversion type available for selection in the schema.
Relevant Test Cases:
Resolution: The committee will need to resolve this.
- D-15. The number of measurements in a measurement list is not found in the schema.
Relevant Test Cases:
Resolution: This can be inferred from the structure of the schema.
- D-16. C-1\CO\N and C-1\CO-1 not listed in XML.

Relevant Test Cases: [TC-18](#)

Resolution: Committee to resolve.

- D-17. C-1\DCT (Data Conversion Type) not listed in XML (TMATS Handbook, page 3-12). The attributes and elements are identical, it is an issue in the schema.

Relevant Test Cases: [TC-19](#)

Resolution: Committee to resolve.

- D-18. The schema has no way to validate named algorithm (“N”) or formula (“A”).

Relevant Test Cases: [TC-21](#)

Resolution: Committee to resolve.

- D-19. There is no way to describe all of the various aspects of video encoding. A standardized list of encoding standards is needed.

Relevant Test Cases: [TC-26](#)

Resolution: Committee to resolve.

- D-20. SP is not listed as an element in XML.

Relevant Test Cases: [TC-27](#)

Resolution: Committee to resolve.

- D-21. Schema key constraints are broken. Instance documents can be created with invalid key constraints and the instance document will validate.

Relevant Test Cases: [TC-5](#), [TC-6](#)

Resolution: KBSI will investigate and provide a fix to the schema.

5.2 IHAL

- D-22. No way to model the connection between a card and a specific slot in IHAL use description.

Relevant Test Cases: [TC-28](#)

Resolution: Committee to resolve.

- D-23. No way to model Calibration Type, Lead Length, Lead Insulation Type, Sheath Type, Sheath Diameter for thermocouples in the IHAL pool.

Relevant Test Cases: [TC-28](#)

Resolution: Committee to resolve.

- D-24. Unable to define compatibility between device connections. How do we know that two devices can be connected and will work properly together?

Relevant Test Cases: [TC-30](#)

Resolution: Committee to resolve.

- D-25. “Bit Rate”, “Snarfer Filter”, and “Check for Parity” are not first-class IHAL attributes associated with bus monitoring in IHAL.

Relevant Test Cases: [TC-30](#)

Resolution: Committee to resolve. Determine if any of these should be modeled in IHAL and, if so, add them to the schema.

- D-26. No clear way to map measurements to data stream messages with the MDL concepts currently imported by IHAL.

Relevant Test Cases: [TC-30](#)

Resolution: Committee to resolve. Determine if there are other portions of the MDL schema that should be imported into the IHAL schema.

- D-27. No support for an sstDataEncoder card. Current structure assumes it will be part of the DAU or an “instrument”, not a card.

Relevant Test Cases: [TC-31](#)

Resolution: Committee to resolve.

- D-28. “Stream ID” and “DAU ID” are not first-class IHAL attributes associated with PCM encoding in IHAL.

Relevant Test Cases: [TC-31](#)

Resolution: Committee to resolve. Determine if any of these should be modeled in IHAL and, if so, add them to the schema.

5.3 DDML

- D-29. The param element requires a param sub-element that causes an infinite loop, making it so instance documents that use the element cannot be validated.

Relevant Test Cases: [TC-33](#), [TC-35](#), [TC-36](#), [TC-37](#), [TC-38](#)

Resolution: Change the schema so that a param sub-element is not required for every param element.

- D-30. Map bounds can only be stored as latitude and longitude values.

Relevant Test Cases: [TC-37](#)

Resolution: Add various formats for storing boundaries.

- D-31. If display objects are arranged in a grid, gridlines cannot be shown.

Relevant Test Cases: [TC-45](#)

Resolution: Add a show gridlines element to the schema. Alternatively, add a border display object that can be placed around other display objects.

- D-32. If display objects are arranged in a grid, gridline color cannot be assigned.

Relevant Test Cases: [TC-45](#)

Resolution: Add a gridline color element. Alternatively, add a border display object that can be placed around other display objects with color selection.

- D-33. Display objects cannot be hidden.

Relevant Test Cases: All

Resolution: Add a show display object element to the schema.

D-34. Custom functions cannot be stored.

Relevant Test Cases: N/A

Resolution: Add a new schema for storing function information.

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APPENDIX A

Citations

- Range Commanders Council. *Data Display Markup Language (DDML) Handbook*. 127-17. January 2017. May be superseded by update. Retrieved 1 February 2017. Available at http://www.wsmr.army.mil/RCCsite/Documents/127-17_DDML_Handbook/.
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